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ABSTRACT

This document compiles an "honest list" of what is needed for adult numeracy. The first section consolidates the four posited Massachusetts Adult Basic Education (ABE) Math Standards into three adult numeracy themes: relevance/connections, problem solving/reasoning/decision making, and communication. A discussion of each theme is followed by some implications for learning and teaching. Each of the next five sections provides content and explanations as well as some activities and ideas that can be adapted for specific situations. Section 2, Competence and Self-Confidence, focuses on adults' feelings and attitudes toward math. The affective issues--learner self-confidence, attitudes about mathematics, beliefs about what one can and cannot accomplish in mathematics, and math anxiety--are covered. Sections 3-6 integrate the remaining seven Massachusetts ABE Math Standards into four adult numeracy content themes. Number and Number Sense includes two previous standards: Estimation and Number, Operations and Computation. The Data theme is similar to the standard of Statistics and Probability. Geometry: Spatial Sense and Measurement incorporates two previous standards. The two standards of Patterns, Relationships, and Functions, and Algebra correspond to the adult numeracy themes of Algebra: Patterns and Functions. The final section lists 31 resources. (YLB)

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Adult Numeracy Themes
Ohio Mathematical Planning Committee

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INTRODUCTION

In October 1995, the National Institute for Literacy (NIFL) funded eight planning grants for system reform and improvement as part of the *Equipped for the Future (EFF)* project. World Education, Inc., in Massachusetts, in cooperation with five state literacy resource centers, accepted the grant on behalf of the Adult Numeracy Practitioners Network (ANPN). The purpose of the ANPN Planning Grant is the begin the work of developing Adult Numeracy Standards for adult basic education. This augmented previous work done in the area by NCTM, SCANS, Massachusetts ABE Math Standards, etc. by interviewing adult learners, teachers and other stakeholders.

This project, while furthering the work of the other projects, was exciting in that the voices of adult learners as well as stakeholders were added to the mix. Based on all the voices along with the work done previously in the area of adult numeracy, the following seven themes emerged and serve as the foundation for adult numeracy standards:

* **Relevance / Connections**
* **Problem Solving / Reasoning / Decision Making**
* **Communication**
* **Number and Number Sense**
* **Data: Data Analysis, Probability and Statistics, and Graphing**
* **Geometry: Spatial Sense and Measurement**
* **Algebra: Patterns and Functions**

Along with the seven themes noted above, adult learner and stakeholder voices also gave us greater insight into affective issues. A section on **Competence and Self-Confidence** was added to ensure that adults' voices were heard and their feelings considered, also. Adults were asked what they need to know and be able to do to be productive citizens, workers, and parents. In addition, the adults were asked their opinions on how math instruction should be changed in the classroom while stakeholders tended to look at system reform issues. From the uniformity of voices of adults across the country, Recommendations for System Reform was drafted. Although the final form of this document is not yet available, much of what is included in this book is from the preliminary drafts.

In March 1994, over 100 adult educators, mathematics educators and other stakeholders in the field of adult education and training came together for three days to discuss the topic of adult numeracy. **Jean Stephens,** Director of the Ohio Literacy Resource Center and instructors, **Nancy Markus** and **Sheila Sipes-Jones** attended this conference. One of the major suggestions of the Conference on Adult Mathematical Literacy was that an important next step would be to develop an "honest list" of the skills and knowledge that adults really need to be mathematically literate. The participants called for a serious rethinking of the content and relevance of the adult basic education mathematics classes as they are currently taught. Through analysis of the mathematical demands on adults in today's society, educators can refocus the adult curriculum in a meaningful way.

In Ohio, **Nancy Markus,** of the Ohio Literacy Resource Center, convened a group of educators to be **team leaders** to participate in this NIFL grant as well as a 353 Grant from the state of Ohio. During the past year, this group has met and looked at documents the *SCANS Report,* the *1994 Conference Proceedings*, *Equipped for the Future*, the *Massachusetts ABE Math Standards,* and the *NCTM Standards*. These team leaders also conducted focus groups to look at specific parts of adult mathematical curriculum. During this past year, these focus groups met throughout the state to try to look at their part of the curriculum in the spirit of reform.

The following team leaders worked hard for the entire project this year. They worked on the NIFL grant, helped plan the "Math Kick-Off Days", and were in charge of a regional focus group. Their hard work and expertise was essential and appreciated. The focus group themes are listed also.

Patti Bilyeu - Algebra
Lois Borisch - Statistics and Probability
Sonja Brown - Measurement
Susan Cann - Problem Solving
Charley Flaig - Estimation
Delores Jones - Statistics and Probability
Paula Mullet - Geometry and Spatial Sense
Diane Ninke - Connections/ Life Skills

The focus group members spent this spring looking at the above topics. They contributed to this notebook. Many of them are presenting material at the

"Math Kick-Off Days". Their hard work during the focus group meetings is also appreciated. The following Ohio mathematics educators were valued members a focus group during the entire project:

Roberta Altic
Dee Bell
Beatrice Benton
Minnie Brown
Becky Brunotte
Jennifer Cutler
Maureen Daly
Megan Dixon
Leslie Enoch
Betty Finney
Susan Galandiuk
Cynthia Grantz
Carolyn Gross
Karen Howell
Kathryn Jackson
Michelle Kerns
Diane Kemer
Brenda Lehmant
Joan Lindhurst
Catherine Lippert
Sharon McConnell
Kathleen McDonnell
Joann Minnick
Melody Robinson
Geri Ryan
Linda Sullivan
Patricia Talbot
Tamara Wagner
Paula Weed

Jean Stephens, Director of the Ohio Literacy Resource Center, has led the Ohio Mathematical Planning Committee through these and many other projects. We thank her for her vision of mathematical reform. **Denise Shultheis**, supervisor, Division of Vocational and Adult Education, Adult Basic and Literacy Education of the Ohio Department of Education, was a valued member of the NIFL grant working group. She has been invaluable in all phases of the math projects this year. Finally, **Jim Bowling,** assistant director Division of Vocational and Adult Education, Adult Basic and Literacy Education of the Ohio Department of Education, has provided essential on-going support for the Ohio Mathematical Planning Committee. We thank him for understanding the need for staff development in order to effect change.

The following materials are some of the activities and ideas discussed and developed by these focus groups. We hope that you look at these activities in the spirit that they were developed. We want you to think how they might be adapted for your specific situation. We hope that some of what is included will be helpful to you.

We all hope that you read the content and explanations in this notebook, as well as try some of the activities. The time has come for system reform, for a better, more meaningful approach to mathematics instruction at all levels. We hope that you will begin to "join the discussion", to reflect on your teaching and learning, and to begin to move towards more effective, "sense making" instruction.

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Material included in this book comes from all focus group members as well as from *A Framework for Adult Numeracy Standards: The Mathematical Skills and Abilities Adults Need to be Equipped for the Future* compiled by Donna Curry, Mary Jane Schmitt, and Sally Waldron. That document includes the results of The Adult Numeracy Practitioners Network Planning Project for System Reform, funded by the National Institute for Literacy (July, 1996).

A Framework for Adult Numeracy Standards: The Mathematical Skills and Abilities Adults Need to be Equipped for the Future was written to provide a base for the continued work of the Equipped for the Future Initiative of the National Institute for Literacy as well as to provide Adult Numeracy Practitioners Network members and all adult education math teachers with a rich consensus document to work from. We, in Ohio, were fortunate to be able contribute to this project.

The Adult Numeracy Practitioners Network is a national organization dedicated to furthering reform in mathematical instruction through support of teachers.

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ANPN STANDARDS FOR MATHEMATICAL LITERACY

There are three "process" standards for adult numeracy. The Massachusetts ABE Math Standards posited Problem solving, Communication, Reasoning, and Connections. Through ANPN's further research, these four standards, often referred to as the "**process**" standards, were consolidated into three adult numeracy themes: **Relevance/Connections, Problem solving/ Reasoning/ Decision making,** and **Communication.** Responses from the ANPN study showed that it was difficult for individuals to distinguish between problem solving and reasoning, both key skills in decision making. The data also revealed that the issue of relevance frequently occurred.

The remaining seven Massachusetts ABE Math Standards have been integrated into four adult numeracy **content** themes. **Number and Number Sense** includes two previous standards, Estimation and Number, Operations and Computation. **Data** is similar to the standard of Statistics and Probability. **Geometry: Spatial Sense and Measurement** incorporates two previous standards. The two standards of Patterns, Relationships, and Functions, and Algebra correspond to the adult numeracy themes of **Algebra: Patterns and Functions.** This reorganization is a reflection of the words of adult learners, teachers, and stakeholders as they told the ANPN about the math that they need and use.

In addition to the three process and four content themes, a good deal of data collected dealt with mathematical empowerment. These affective issues continually emerged. Learner self-confidence, attitudes about mathematics, beliefs about what one can and cannot accomplish in mathematics, and math anxiety all were repeated. It is believed that when adults talk about the affective aspect of math, they are referring to their self-confidence in doing math and their sense of competency around tasks involving math. Therefore, there is a section on adults' feeling and attitudes about math, titled **Competence and Self-Confidence.**

These are not the final standards but merely a framework of themes for developing true standards, a true "honest list" of what is need for adult numeracy. Much more work and reflection remains. This is merely the beginning and we invite you to be a part of it.

ANPN NUMERACY THEMES

PROCESSES:

1. **Problem Solving/ Reasoning/ Decision Making**
2. **Communication**
3. **Relevance and Connections**

CONTENT:

1. **Number and Number Sense**
2. **Data: Data Analysis, Probability and Statistics, and Graphing**
3. **Algebra: Patterns and Functions**
4. **Geometry: Spatial Sense and Measurement**

Competence and Self-Confidence

RELEVANCE / CONNECTIONS

Adults need to see connections in math -- connections within the domain of math itself, connections to other disciplines, and connections to real life and work situations. Math takes on greater meaning and understanding when it is directly applied in the workplace or in real-life situations. Many adult learners feel that their best math situation was when they learned math at work. This suggests that the math they learned on the job was directly applicable for them.

Adults see little relevance or connections between math and their everyday living and working conditions. Adults often ask, "What is it used for?" about math topics that they, thus far, have seen little relevance or connections in their everyday living and working situations. **Adults feel they are more successful when they are able to link any new learning to something they already know. Textbook math, and particularly word problems, seem to have little relevance to what adults perceive as math in everyday life.** Adults's real math skills often don't show when they do meaningless word problems. Adults often actually use math successfully in their daily lives, yet fail to see any connections to work problems presented in the class.

IMPLICATIONS FOR LEARNING AND TEACHING

Math must be taught in the context of real-life and workplace situations. When math is taught in context, adults understand that there is a practical application for that skill. Teachers may need to become more knowledgeable about the world of work in order to offer relevant math curricula.

Learner-centered approaches to teaching ensure that learners see the relevance of what they are learning. Math learning for adults should be relevant to their own personal goals, whether it be to attain a GED certificate, a job, or whatever. Adult learners need to have a voice in what is taught in the classroom. The teacher may think something is important for the adults to learn, but unless the learner sees the relevance to his/her own life, he/she finds little value in the topic. Whether teachers "hook" the students or get them to "buy into" the math, adults will find the relevance when the material is relevant to their needs and goals.

Interdisciplinary approaches to teaching are essential. Math should be an integral part of other content areas.

New math learning should be linked to previous learning. Linkages should be made with other math concepts and skills as well as with other prior knowledge. Not only should the new learning be connected to prior learning, but there should also be a connection between knowing how to perform a skill and being interested in performing that skill. Concepts should be taught before rules. This time is well worth the benefits that will result.

We must help adults see the relevance of learning by seeing the "big picture". When adults see how math skills are interconnected with one another, they begin to see relationships and the relevance of what they are learning.

PROBLEM SOLVING / REASONING / DECISION MAKING

Problem solving, reasoning, and decision making are three very interconnected processes adults engage in continuously, whether they are using numbers of words. The *SCANS* report defined these higher order thinking skills as follows:

Problem solving entails that persons recognize that a problem exists, identify possible reasons for this discrepancy, and devise and implement a plan of action to resolve it. The problem solvers evaluate and monitor progress and revise the plan as indicated by findings.

Decision making entails that persons specify goals and constraints, generate alternatives, consider risks, and evaluate and choose the best alternatives.

Reasoning entails that persons discover a rule or principle underlying the relationship between two or more objects and apply it in solving a problem. For example, the persons must use logic to draw conclusions form available information, extract rules or principles from a set of objects or written text, apply rules and principles to a new situation, or determine which conclusions are correct when given a set of facts and a set of conclusions.

Reasoning is a key step in problem solving and decision making. Adults use reasoning to analyze information in order to solve problems which, in turn, allows them to make reasonable decisions.

Math skills are integrated in the problem solving and decision making processes. Although it is clear that math skills are integrated in the problem solving and decision making process, the skills needed vary from problem to problem. The math skills needed to solve problems and make decisions are integrated throughout the process, with more than one math operation generally being required to come to final decisions.

Problem solving is a process that includes seeking to understand the problem, the figuring out what information and math skills are important to use to solve the problem. It is clear that the process of solving problems requires an understanding of the situation. Problems cannot be solved without the understanding of the situations.

It is important for adults to have a repertoire of strategies and tools to solve problems. These varied strategies include the use of calculators. While many persons are not yet convinced as to the importance of calculator use, it is important to note that the *SCANS* report lists "technology" as one of the five important competencies necessary for a literate workforce.

Problem solving and decision making often involve teamwork. On the job and in daily situations at home, problems are solved and decisions made with the advice and input of others. While in school situations, teamwork is not as often encouraged, at home, and in the community, individuals must work together to solve problems and more forward.

Parents, workers, and community members use problem solving and reasoning to reach decisions. Being able to problem solve successfully in the workplace gives workers more confidence, which in turn, gives them more of a voice. Adults use problem solving strategies as parents to "survive". They need to maintain budgets and comparison shop. Adults also use problem solving strategies to better understand how their money is manipulated. Adults, in their role as citizens, also have to solve problems and make decisions using numbers.

IMPLICATIONS FOR LEARNING AND TEACHING

Math content skills must be embedded in processes like problem solving, reasoning, and decision making. Processes such as problem solving are viewed as more than just a topic to be covered in an adult education classroom. Mathematics must be real, not just pseudo-real problems in a book.

Reasoning and problem solving should be integrated in all teaching. Even when teaching basic skills, such as reading, writing, and math, higher level thinking skills such as reasoning, problem solving, and decision making should be incorporated into the lessons. Reading and mathematics become less abstract and more concrete when they are embedded in one or more of the higher level thinking skills. One need not choose between basics and higher level thinking; students become more proficient faster if they learn both simultaneously.

Learners must be provided with opportunities to work in groups. Learners do learn from one another. Working together in groups also gives learners opportunities to hone personal qualities such as self-esteem, sociability, self-management, integrity and honesty. Interaction is not only a key foundation skill, it

is one of the five major competencies needed in the workplace according to the *SCANS* report. Competent employees are skilled team members and teachers of new workers; they serve clients directly and persuade co-workers either individually or in groups; they negotiate with others to solve problems or reach decisions; they work comfortably with colleagues from diverse backgrounds; they responsibly challenge existing procedures and policies.

Skills like these are not developed overnight, nor are they simply "picked up". Learners need to interact with their peers in problem solving teams within the classroom environment. Adult learners need to work in group situations in order to learn to check reasoning and take advice and suggestions from others. Genuine respect and support of each other's ideas is essential form learners to be able to explain and justify their thinking and to be able to understand that how the problem is solved in as important as its answer. In all adult basic education math settings, the development of critical thinking skills is crucial. Statements should be open to question, reaction, and elaboration from others.

COMMUNICATION

Math is language. Mathematical communication is an overarching process which includes understanding, expressing, and conveying ideas mathematically in order to reflect on and clarify one's thinking, to make convincing arguments, and to reach decisions. Effective workers must be able to interpret and communicate information and communicate ideas to justify positions. In the workplace, much of this information and many of these ideas are mathematical.

Mathematical communication can occur in any relationship and context. In the ABLE setting, communication happens among learners and between learners and their teachers; at work among workers and between workers and their supervisors; at home among family members and between children and their parents; and in the community among individuals and between community members and public officials. Good mathematical communication is like all other effective communication requiring listening, speaking, reading and writing skills along with interpersonal skills.

Communication is essential for understanding. Communication provides the foundation for learning in school and in life. Communication includes knowing when and being able to ask for help both in the classroom and in life. Communication, in math as in other aspects of life, is the bridge to finding and exchanging ideas, to identifying problems, and to seeking and finding solutions to these problems. Communication is essential to working collaboratively at home, at work, and in the community. Communication is the link that makes other math skills effective.

Mathematical communication, the representation of a problem in mathematical language, also happens in the "other" direction, especially as individuals interact with technology. As technology becomes more pervasive, it is necessary for one to be able to distill the elements of a real situation into a mathematical expression, the universal language. In order to communicate the problem to any one of our technological aide, it first must be translated to symbols and then the results from the machine must be interpreted in light of the situation.

IMPLICATIONS FOR LEARNING AND TEACHING

The focus on mathematical communication should be increased. Teaching mathematical communication is integral to the success of math reform

efforts. Students always working by themselves with no requirements that they communicate their problem solutions to anyone else is not helpful for their progress. Pairings and small group work are viable alternatives to whole-classes instruction, especially in light of rolling enrollment due to open-entry, open exit classes. Teachers need to use a variety of approaches, models, and manipulatives and have the students involved in talking about their work with each other on a frequent and regular basis.

Good mathematical communication for work, home, and community situations through group discussions should be encouraged. Math should be taught using a well-defined vocabulary of math terms so that what the teacher believes is being taught is what is being received by the student. This should involve verbal and written feedback from the students to confirm that they understand and can express to teachers what they know. As a skill necessary to future employees, students should be able to express mathematical ideas and concepts orally and in writing.

COMPETENCE AND SELF-CONFIDENCE

The loss of self-confidence in math, the lack of understanding of particular math concepts, and the fear of math inhibits power. Many adults do not feel confident, competent, nor comfortable in math. Many adult learners are frustrated because they do not feel comfortable in math. Adults fear math. For some, frustration with math spreads to frustration in other areas of school as well.

Is this lack of confidence in math because people are limited or lack the ability to learn? No, the causes are more likely found in poor learning environments and lack of recognition of different learning styles and needs. **Good learning environments, within the family, at work, or in school, produce different attitudes toward math and can help to overcome fear and lack of belief in one's ability.** Confidence builds competence in math and competence builds confidence. Sometimes confidence in math comes after gaining self-esteem as an adult. Math skills may also be acquired on the job.

Those learners who feel comfortable with math have confidence in their ability and respect for the domain of math. Confidence in math increases power, voice, and the ability to act. The more adults learn, the more confident they become, and the more enjoyable the experience of learning becomes.

IMPLICATIONS FOR LEARNING AND TEACHING

Teachers need to become comfortable presenting math concepts using a variety of strategies and approaches. There are many ways to solve a problem or even do a calculation! Teachers need staff development where they can share with each other successful teaching strategies. Teachers need to become comfortable using manipulatives, calculators, computers, whatever it takes for learners to grasp math concepts.

In recent years, more research has been done in the area of math learning. This research has revealed that individuals learn math differently than we thought. Some are comfortable with learning step by step while other learners tend to jump to the big picture and work forward and backward to solve problems. Teachers need to let go of the need to make all learners solve problems the same way that they were taught in school.

Success needs to be built into the adult education classroom. Adults need

to have success early on and often when they begin a math class. This success enables them to develop confidence in their ability to do math, which in turn paves the way for further positive math learning experiences. All individuals benefit from positive feedback, but it is particularly important that adults who have experienced failure in math class previously now find success in the adult education classroom.

Math content skills need to be presented in the context of real-life situations. When learners can immediately apply what they have learned, the learning crystallizes and the learners gain confidence and competence in their math ability. The perception is that math is too hard and that perception must be changed.

Connecting to real-life situations and understanding the why behind math processes improves math ability. Adults use math in their daily lives but often do not connect to their real world math to the math in the classroom. When asked whether they use math, adults who are not confident in math will often say that they don't use math. Connecting math to their real-life situations helps adults understand that they do use math.

There needs to be a level of trust in the adult education classroom. The adult education teacher needs to build an environment that is comfortable for adults and one in which adults can be open. Adults need to feel comfortable sharing their frustrations and lack of math skills.

Group work is one technique that helps build confidence and competence. Isolating learners from each other is not helpful nor efficient. In our global economy, much of what we do is done in groups. By becoming more familiar with cooperative group learning, the teacher can maximize the potential of all his/her students.

MATH ANXIETY

Math is mainly arithmetic!
Math is a lot of memorization!
You must follow the procedures set down by the teacher or textbook only!
Every problem has only one answer!
You have to be a genius to do math!
I hate math!

Have you said or asked these before? If so, you are experiencing math anxiety. Math anxiety is not a myth. Approximately 50% of the adult population in any occupation suffer from this very real condition. Math anxiety is a state of uncertainty; disturbance of the mind regarding the subject of mathematics.

HOW IT HAPPENS

No one is born with math anxiety. It is a learned process. This barrier of learning is usually not found in elementary school. Most people say it started for them in fraction, algebra or geometry. An unsafe environment took place either at school, home or at both places. The process of math anxiety always involves another person besides the victim.

For example: In the book Math Anxiety Reduction by R. Hackworth, math teachers were questioned about their subjects. A large majority stated,"These subjects were far higher than basic math levels, and only the exceptional minds can grasp this knowledge."

It was later discovered that these teachers,themselves, suffered from math anxiety. The attitude that only the most intelligent could do these tasks reached the students' minds and there it started to grow. This made these teachers unknowing helpers for math anxiety.

WHO IS A GOOD VICTIM FOR MATH ANXIETY?

According to Fear Of Math by C. Zaslavsky, in the 1970's females were more of a target than males. Today that has switched around. Males are more likely to suffer from math anxiety than females. The American culture has general expectations of the male and female roles. Males are seen as the breadwinners of the family. They think they should make all the decisions, handle everything on their own and never have to ask for help. The male ego says if you ask for help you have failed as a man. Our culture makes people who fail feel weak,stupid and sometimes incompetent. Females , today know they are just as smart as males. Yet they are still seen as the group gossip hostesses who talk to anyone about anything. Math anxiety must hate this. If a female is feeling uncomfortable with a math question they are more likely to admit the problem and ask for help, this decreases the chance for math anxiety.
As teachers we need to be alerted to pride, it seems to be math anxiety's best friend.

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SYMPTOMS Math anxiety can have internal and external symptoms-heart throbs, sweaty palms and mind blanks along with severe fear of the subject and a total avoidance of math in general. To reduce the stress level of your students Fear Of Math and Math Anxiety Reduction suggest the following

Check the learning styles of your students
- do they work alone or in groups
- competitive or cooperative environment
- oral or written methods
- do they mull over or blurt out answers
- the speed of the work
- persistence of work or to stay on task

Try the relaxation Technique
- stop what you are doing
- take deep breaths (out of your nose)
- clear your mind
- relax your total body
  - start with your toes and work up slowly

For best results do these exercises 20 minutes before starting any math work.

Give more control to the student in helping them devise realistic educational goals.

Have students keep a journal to monitor their own learning activities.

Use more real-life math
- an example: Draw a map from work to your house with the use of landmarks. Here the students are doing something familiar to them not realizing they are using geometry, algebra, measurement and problem solving.

Try more estimation problems. Students become more relaxed when they know there is more than one correct answer.

Stress clue words for story problems.
- each = multiplication or division
- sum or total = addition
- difference= subtraction

Show students how to check their own work.

Encourage group work.

These stress reducers can help raise self-esteem and the drive to try again. Remember, there is no quick easy cure for math anxiety. For some there may be no cure at all, just the ability to cope.

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SMALL GROUP LEARNING

The sixth strand of the NCTM standards deals with conceptual and procedural knowledge of mathematics. The standards state that this means the learner must have the opportunity to develop proficiency with various models in all operations. One of the best resources we have found for instruction in all areas is the use of small group work. Group learning might also be called team learning.

In the March/April, 1996 issue of Adult Learning in an article by Victoria J. Marsick and Karen E. Watkins, "Adult Educators and the challenge of the Learning Organization," we find out what an important concept working as a group or team is:

"Dechant, Marsick, and Kasl (1993) and Brooks (1994) in separate studies show that teams mutually create new knowledge through continuous cycles of thinking and acting. Teams use new ideas and information to challenge their current understanding, and to then test new insights through trial-and-error and experimentation, which leads them back through a similar cycle. Dealogue and inquiry enhance team learning."

Other benefits derived from group learning include:

OPTIMUM INTERACTION--interaction is an integral part of the learning process.

AVOIDING ISOLATION--learning does not take place in isolation.

ORAL LANGUAGE DEVELOPMENT/NOISE LEVEL--oral language development plays an important role in learning.

A SUPPORTIVE ENVIRONMENT.

EMPHASIZING THE PROCESS--emphasis must be on the process, not the answer.

STUDENT/TEACHER ADVANTAGES--

- -social interactions
- -opportunities to be teacher and student

-solving problems together is more efficient and enjoyable than working by one's self
-reduces teacher effort
-immediate feedback
-teacher can be learner also
-it works.

This is not the type of group work that needs to be led by an instructor or volunteer. We have learned that students work best leading their own groups with teacher guidance and guidelines. Students often fall into small groups on their own: whom they sit by daily, whom they are friends with, or whom they know is "good at" what they are working on. These small groups will work but it may be more advantageous for the teacher to group students according to their abilities and work styles. Once these groups are established is best to keep them together for a number of lessons because the students learn to work with one another and feel more secure being more familiar with one another. These groups would probably change according to subject area or activity. Six students would be the maximum number of students that should work together.

Several guidelines are suggested for small group work: 1) everyone should know everyone else's name; 2) no question should be asked of the teacher unless everyone in the group has the same question; 3) each person must be responsible for their own behavior; and 4) each member must be willing to help every other member of the group.

Students have repeatedly told us that they not only enjoy working in small group situations, but they feel they gain much more than working on their own. They learn from the other members of the group and they learn by explaining what they already understand. They share ideas and come up with more ideas than they would have been able to by themselves. They don't feel "so dumb", because they see other people struggle as well as themselves. Many

activities can be used in the small groups. Problem solving is probably one of the best concepts to with. Many cooperative learning books, such as GET IT TOGETHER, SPACES, and Make It Simpler are all books that will help get both teacher and student started.

Waving the White Flag

Surrendering our traditional approaches to Mathematics in Adult Education

The battle to arm our adult learners with solid mathematics skills is often lost at the most fundamental level. The way instructors introduce specific mathematics concepts sets the stage for the success, or lack of it, that students have in mastery. We must approach mathematics with concrete strategies that not only show the learner how specific functions of mathematics work, but why they work.

Students will readily admit that the subject they disliked most in school when they were young was math. Often, they lack a fundamental understanding of basic concepts such as division and multiplication. Many students will say that they have no trouble with these skills unless they have to determine which to use in a word problem. The reason for this is that word problems demand a far deeper conceptual understanding. Rote memorization is a very small part of mathematics. Mathematical operations have to be understood in a fundamental way, as do all aspects of math , so that the student can withstand the tests of logic and critical thinking that come with every day of life.

If we approach math as a sort of laboratory science, we can experience the same moments of discovery that our mathematical forefathers did. Why is a base ten system so helpful in counting, adding, or subtracting? Why does it make so much sense to quickly add groups of numbers and call it multiplication? How can we use division to lead into the concept of fractions and then later on prove that fractions can't be divided? Because they are adults, teachers are often uncomfortable working with such primary concepts. The fact that they are 'primary' is all the more reason to make sure we approach them as a necessary function of being a successful mathematician. Accordingly, we must approach each element of mathematics in the same fundamental way, as if we have to prove it before it can be true.

The members of our team were in agreement that manipulatives and real life situations are the best way to generate interest in new concepts. Any physical entity that students can hang on to works as a kind of security blanket for temporary support. The goal is to outgrow our 'blankies' at some point in time and move on to something else. Games are certainly one way to conceal mathematical objectives. A spoonful of sugar really does help the medicine go down. Variations on Bingo can be used regularly to check student understanding for any subject, but first there has to be understanding. It was our goal to consider some of the most important objectives for instructors to successfully approach mathematical concepts. These are:

* Introduce students to mathematics by asking questions
*Allow students to explore concepts without formulas or preconceived explanations
* Create an environment of exploration with manipulatives or tools that are visual in nature
* Take the time to research mathematical ideas to better understand mathematical formulas. (You may have taught circumference, but can you explain 'pi'?)
* Provide opportunities for success to contradict the self-prophesy that "I never was good in math."
* Avoid the copy machine. It's a sure sign that your using the same method by which you learned math.

None of us find it easy to surrender our weapons. Paper and pencil just seem to be the traditional tools of mathematics, and we can't help but grasp for them when we teach. What we all realize is that this route did not work for our students the first time around, and chances are it will only fail again. The discomfort we all feel is that manipulatives seem so juvenile. The last thing we want to do is insult these adults. However, by dissecting concepts as if they were biology experiments, teachers as well as students learn to appreciate the remarkable world of mathematics as less of a battlefield and more of a field of discovery.

Why a BASE 10 System? *Have students learn more about the Egyptian number system. Let them make up one of their own. Let them use money to focus on place value and talk about adding and subtracting. Discuss ways to calculate answers without adding or subtracting in columns.*

What is multiplication? *Most students do not think of multiplication as anything more than memorized facts. Provide groups of pennies, nickels, dimes, and quarters, then have them discuss how they calculated totals. Explore different ways to calculate totals, such as groups with 2 quarter, 3 dimes, and 4 nickels.*
Graph paper cut into assorted shapes works well also.

When is division really division? *Thinking of division as an inverse operation has little meaning once we begin to go deeper into math. Division must be understood as cutting things into equal parts. This is quickly associated with fractions. Have students cut up paper or cookies, or split a restaurant tab. Use specific numbers of cards or candy and have them divide things up fairly.*

Do you understand a fraction of this math? *Look for fractions everywhere until students see that they are not just book work. Measuring spoons, screws and nails, telling time, etc. Give students an 1/8 cup and tell them you need 3/4 cup of water. Have students prove that the second fraction must be inverted in division.*

What is the point of a decimal? *Money is everyone's favorite decimal number. Work with place value and make reference cards for students to place numbers on. Use less than a dollar in change and have students write the amount they have. Why do we write it that way? What if we didn't use a base 10 system? Use circles cut in 10 pieces, having them write decimal equivalents.*

What does this symbol (%) really mean? *Most of us spend so much time teaching how to find a percent that students rarely understand what a percent actually is. Spend time cutting up apples or cheese and discussing parts of the whole and percents of the whole. Always start with 100%. Use 10% to approximate answers (30% is three 10%s) Lots of real life application.*

Do you believe everything you hear? *Geometry is the most terrific area in math. It is visual to begin with and can always be proven The three angles of a triangle always equal 180*. Mark each vertex, then cut them off and put side by side. Pi is the diameter of a circle placed around the outside edges 3.14 times. Let students do it. Pythagorean Theorem helps use check for perfect corners when building. They call it a 3-4-5 corner; measure 3 inches, 4 inches on the other side, your marks should be 5 inches apart across the corner.*

Do you speak Algebraic? *It's a foreign language to many students so do everyone a favor. Teach them the basics -signed numbers and the order of operations. Then work on translating English into Algebraic using simple equations , then real life situations. Use thermometers and number lines, let students move physically through addition of signed numbers. Stay away from long equations that only your college- bound students need to digest. Try to avoid the word* algebra *if possible.*

Teaching Math With the Use of Computers

Learning math can tend to be tedious and confusing to many adults. Often times, just hearing the word math scares people. Learning math techniques through the use of a computer is an effective way of explaining difficult concepts to students. Computer software can be individualized to each student's particular learning needs, which can allow students to progress more rapidly and easily. Classroom teaching is always effective, but the new age of computers is making it an absolute necessity to bring computers into the classroom. In a typical classroom, students of varying motivation and ability levels are grouped together. This may be cause for confusion among both the students and the teachers. Students may be confused about the material presented, and teachers may be confused about how to present the material to the varying ability levels. Computers are a perfect intervention for this type of educational problem. Through the use of computers, students can enjoy an individualized curriculum that is specifically assigned to their educational needs and abilities.

An educational computer software program that addresses the needs discussed is WICAT. WICAT is designed for adult users with reading and math levels from 1st through 12th grade. It addresses math concepts beginning with whole numbers, and moves through fractions, decimals, and percents. It then moves into geometry, algebra, trigonometry, and basic beginning calculus. WICAT also addresses job skills and life skills, including money management

activities. In addition, GED science and social studies activities are available. WICAT will soon update its software by adding such topics as drug and alcohol rehabilitation.

The program is extremely effective in educating students. It provides immediate positive feedback by instantly presenting the score correct to the student completing the activity. It provides positive comments for work well done, as well as immediate intervention when problems arise. If a student does poorly on an activity, a screen appears telling the student to call his/her teacher. If a student gets a 70% or below, the "call your teacher" screen appears. This allows the teacher to step in and assist the student with whatever problems he/she may be having. The teacher must then type in a password to delete the screen and allow the student to get back to work.

The software is quite detailed in its explanations of topics and concepts. For example, when doing a long division problem, the students are required to type in the steps, one at a time, to the problem. This allows the students to work out the problem just as they would on paper. The only difference is that the students receive some type of indication of whether or not the problems were right or wrong. They also would get an idea of where they made their mistakes, if in fact they did.

Another effective use of computers in education is through the use of a touch station. Touch stations can operate through the use of laser discs. However, they are now currently being updated to a C.D. ROM system. The touch station is specifically geared to low level math and reading students. The

station is a tactile, or hands-on, way to learn. Students touch the screen to indicate their choices. The instructions are read to the students in case they have trouble reading in any way. This multi-sensory approach helps learners develop confidence and avoid frustration. Students accomplish more because they don't have to concentrate as much on figuring out the words, just the concepts. It really is quite effective and rewarding for the students.

There are quite a few other software programs on the market now that are effective in teaching math. When teaching adults, it is important to look for programs that are age appropriate. Many of the programs available now for adults in math instruction have a video game feel but aren't too juvenile, therefore allowing students to learn without feeling as if the computer is too immature for them. The programs tend to not actually teach the concepts, but merely reinforce concepts already learned. A list follows with various computer math instruction programs. The prices of the list vary from approximately $10 to $40. So, the programs can be purchased for a fairly inexpensive amount of money.

Multi-Media Fractions
Math Blasters
Treasure Math Storm by The Learning Company
Expert Algebra
Multi-Media Pre-Algebra
Middle School Math
High School Math by High School Learning and Resource Center

Computers are rapidly changing the face of society as we know it. It is imperative that learning, along with other facets of society, enter the technological age of computers. By allowing students to explore educational activities throughout the use of a computer, students will in turn learn more than purely academics. They will become familiar with a computer keyboard while learning and reinforcing newly acquired math concepts. This approach helps to boost self-esteem while teaching concepts. Computers are proving to be an extremely effective form of teaching instruction and learning.

NUMBER AND NUMBER SENSE

Number sense is a content skill that encompasses many areas in our adult education classroom. Number sense needs to be explored using whole numbers, fractions, decimals, percents, ratio, money, and estimation.

Being able to handle numbers comfortably and competently is important to adults as parents, workers, and community members. This competence relies upon having developed a kind of "number sense" about whole numbers, money, fractions, decimals, and percents. Number sense includes calculation skills with numbers as well as a sense of number and operation and an ability to appropriately use estimation, mental math, computation, calculators and other tools.

Computation skills are necessary but not sufficient. Adults must have strongly developed computational understanding of arithmetic numbers as well as some procedural knowledge of computation and number facts. They must be able to perceive the idea of place value and be able to read, write, and represent whole numbers and numerical relationships in a wide variety of way. Simple paper and pencil computations are not enough. Adults must be able to make decisions regarding the best method of computation to use in a particular situation; mental math, paper-and-pencil, calculator/computer. **To demand individual paper and pencil computation from all students at all times does a disservice to our students and society.** Problem solving skills are often best developed using a calculator and group work. Calculator work, mental math, and pencil-and-paper skills are important skills to develop in all students during all class time.

Even deeper to true number sense, are some very basic understanding such as sorting and classifying, comparing, ordering, counting and pattern recognition and development. There "pre-number and pre-operational" understandings apply to all numbers. To jump to computational skills without these concepts often spells disaster. For example, understanding basic fraction concepts is critical to making sense of the operations.

Operation sense or understanding how the four operations work means recognizing conditions in real world situation that indicate that the operation would be useful in those situations. Multiplicative reasoning is basic as it leads to the understanding of multiplication, division, and proportional reasoning. This is the notion of "unitizing" or forming "units of units" where a person begins to groups objects together and consider them as sets or whole. Proportional reasoning is

critical to people's ability to understand and communicate about (rather than compute) what averages and percents are. Anything that is decreasing or increasing or changing magnitude relies heavily on deep understanding of proportions, rates, ratios, relations and relative comparisons. These elements add to a dynamic definition of what we mean by being able to work with numbers.

Estimation and mental math are essential to sense making with numbers. Adults use estimation every day and all the time; it's woven into the fabric of daily decision making. Adults use estimation to predict and plan. It is used to check outcomes. Approximations guide thinking all along the way. It is a sense making activity. People need to be able to decide how precise they need to be in a particular situation.

Fractions, decimals, percents and ratios and their relationships with each other are basic skills. Fractions are often considered a hard topic from school. Yet these concepts are important for further understanding and exploration in math.

Knowledge of numbers is useful to adults in making decisions about issues that relate to their families, communities, and workplaces.

IMPLICATIONS FOR LEARNING AND TEACHING

Numbers must be taught and learned in context right from the beginning. Neatly controlled pages of computation are not the way adults learn best. If we expect life-long learning, we should use real-life problems. Learning how to compute percents in the context of a real life budget will be much more profitable than if taught in the abstract or with artificial work problems.

We must build on an adult's personal number sense. Traditional school math calculation methods are not always useful. The notion that adults should do it the "right way" or the teacher's way robs adults of their mathematical power. Good numeracy instruction must build upon an adult's personal number sense and help further develop that sense so that he/she can handle real life situation. A

Adult educators must begin to question the teaching of "school math" especially when those strategies or techniques are rarely used by other competent adults. The way estimation is often taught, using precise rules for rounding, has nothing to do with the way people really use it in the workplace. The choice of

teaching complicated fraction computation, which will never be used in real life must be weighed against more important and realistic skills.

Number sense enables adults to be able to interpret and represent the world in which they work and live. Good number sense supports the judgements and decisions that lead to independent action. Number sense is truly the cornerstone of mathematics. It is exemplified every day, whether we consider notions as complex as the consumer price index, as pivotal as the impact of the Great Depression, or as personal as a blood pressure reading.

ESTIMATION

There are times when we do not need to know the exact answer to a math problem. Sometimes an approximate answer will be all we need. People make mistakes in math and become of this they need a way to check their answers quickly. There are times when we will want to check our math to see if the answer we have arrived at is a sensible answer. Estimating is most useful in catching mistakes that are "way off" rather than mistakes that are close. It is important to know when an answer is reasonable, and so it is important to use estimation.

Estimation is an important part of the process of mathematical thinking. We need to provide time to *predict, solve and reflect* on our problem solving. Estimation and reasonableness are integral to prediction in a problem.

When you solve problems, you must first decide whether you need an exact answer or an estimate. Remember, even if problems require an exact answer, you can estimate to get the "ballpark" figure or after you complete your work in order to check the reasonableness of your answers.

Estimation is a critical life skill. Most often we use a calculator to solve problems. Being off by a factor of 10 will certainly change the answer even if the digits are correct. Usually in life, we do the "number crunching" with a calculator; we check the reasonableness of the answer using estimation. *These are skills that need to be practiced in class.*

Students need time to discuss instances when they have made estimates. Each instance can lead to a discussion of:

1. What the estimate sufficient or did you need an exact answer?

2. Was the answer reasonable?

Many times it makes sense to estimate. When estimating, remember that often a reasonable answer will not follow the rigid rule of "0-4 round down and 5-9 round up." Try to aim for *number sense*, rather than teaching rigid rules. To that end, endless drills rounding numbers to the nearest ten, hundreds, etc. are probably not beneficial for true number sense.

ESTIMATION
IN PROBLEM SOLVING

ESTIMATING IS A SHORT CUT TO PROBLEM SOLVING WHEN AN EXACT ANSWER IS NOT NECESSARY OR WHEN CHECKING THE ACCURACY OF YOUR ANSWERS. ESTIMATING IS A PROCESS OF DETERMINING APPROXIMATE VALUES. BEING ABLE TO FIND AN APPROXIMATION IS USEFUL IN THREE WAYS:

* To find an approximate answer when an exact answer is not needed
* To quickly check your results after you work a problem exactly
* To quickly pick the most reasonable answer from some answer choices given on some test questions

ESTIMATING IN ADDITION

Suppose you have $1.00. You choose three items at a grocery store that cost 41 cents, 29 cents, and 17 cents. To make sure you have enough money when you get to the check out counter follow the following steps;

$41 \approx 40$ Step 1- Round 41, 29, and 17 to the nearest ten

$29 \approx 30$ Step 2- Add 40 , 30, and 20

$17 \approx 20$ Step 3- Compare 90 cents to the $1.00 that you have

Adding 40, 30, and 20 is quicker and easier than adding 41, 29, and 17 which might require a pencil and paper or a calculator. The estimate you get is close and good enough to save you from embarrassing yourself at the checkout counter. 87 is what you get when adding 41, 29, and 17; 90 is a very good estimation of 87.

ESTIMATION IN MULTIPLICATION

Some multiplication problems can be done without long computation, once you know the right shortcuts.

```
  500
x 70
  000
3500
35000
```

you can compute 70 X 500 this way.

7 X 5 = 35 here is a shortcut you can use to find the same product.

70 X 500 = 35000

1 zero 2 zeros 2+1 or 3 zeros

to estimate products, round each number. Then multiply the rounded numbers using the shortcut.

estimate 37 X 54

37 ≈ 40 4 x 5 = 20

54 ≈ 50 40 x 50 = 2000

1 zero 1 zero 1+1 or 2 zeros since 37 x 54 = 1998, 2000 is a very good estimate.

MULTIPLICATION BY 10, 100, OR 1,000. To multiply by a number such as 40, 400, or 4,000, first multiply by 4, and then multiply by either 10, 100, or 1,000. A number such as 400 is a multiple of 100, since 4 times 100 equals 400.

For example, to multiply $2.20 by 400:

1. **multiply $2.20 by 4. You now have $8.80.**
2. **now multiply by 100 by moving the decimal to places to the right in the first product, $8.80. Now you have $880, which is the product of 400x$2.20.**

MULTIPLYING NUMBERS THAT HAVE END ZEROS. Sometimes either one of the factors, or both, have end zeros. Look at the problem Example A (140x2,000). To do this problem, you arrange and multiply only the numbers to the left of the end zeros. Then you attach to the products as many zeros as there are in both factors.

USING ESTIMATION IN WORD PROBLEMS

Estimation is especially useful in word problems.

* you can use estimation to help you decide which operation is correct for problem solving.
* you can use estimation to check the accuracy of your exact answer.

Example: Last Saturday, Peggy worked 5.75 hours of overtime. If her overtime salary rate is $8.16 per hour, how much overtime did she earn that day?

An estimate can be quickly computed by replacing each number with a whole number and multiplying.

$5.75 \approx 6$ $8.16 \approx 8$

$6 \times 8 = 48$ The exact answer is $46.92

Notice how 48 serves as a good clue:

* First, the amount 48 seems about right. This tells us that multiplication is the correct operation to use.
* Second, you know that the exact answer must be close to 48. If you compute an exact answer that is several dollars away from 48, you'll know that you probably made a mistake. You would then want to recheck your multiplication.

First estimate the answer and then compute by using your calculator.

1. If chicken is on sale for 1.04 per pound, how much would you pay for a whole chicken that weighs 5.95 pounds?

2. How much rock can Bryce carry with his truck in eight loads if his truck can carry 2 7\8 tons on each load?

144	210	320	92	679
512	476	155	197	287

Work with a small group of students.

1) Without using pencil, paper or calculator, each person must pick three numbers from those shown in the chart to add to get a total as close to 1,000 as you can without going over.

2) Write your numbers on slips of paper. Then find an exact answer. Compare results with your group to determine who came the closest.

3) Discuss strategies for picking the numbers and list them. Did you estimate? What estimation method did you use? Why? Vary the activity by picking four numbers to get as close to 1,500 as you can.

Have students in each group create new estimation puzzles for their teammates to solve, using the numbers in the table. Suggest using subtraction as well as addition and limit number use to four numbers. Puzzles might take the form of two numbers whose difference is close to a specified numbers or adding two numbers and subtracting one number to get as close aspossible to zero.

ESTIMATION IN GROUPS

OBJECTIVES: Students will: 1. Learn estimating skills as related to shopping.
2. Demonstrate skills by developing a shopping list.
3. Develop interpersonal skills by group work.
4. Use addition, subtraction, and multiplication of decimals.

MATERIALS: Enough grocery store ad. sheets so each group has one.
Scenerio cards.

GROUP ASSIGNMENT: There are many ways to assign groups. I normally ***stack the deck.*** I assign a confident student to each group initially until the students become confident in working in groups. With group experienced students I normally assign members at random. I never allow students to select. I ask the students to select a leader and to name their group. I then give each group a scenario card. I not only expect an answer but I ask the students to explain the process they used to arrive at the answer.

SCENARIO 1: ESTIMATION

You have $35.00 and must buy enough groceries to feed your family of five for 6 meals. 1. Plan your meals based on the ad. 2. Estimate how much of each item you are buying. 3. You can not go over $35 at the checkout. 4. The group that has the best menu and comes closest to $35 without going over wins. **REMEMBER** You are competing against the other groups, so keep the noise down.

SCENARIO 2: ESTIMATION

Your spouse gave you $55.00 to buy supplies for a family picnic for 25 people, any money left over you can keep. By use of the ads, plan the picnic menu and estimate the cost. The group that arrives at the most realistic menu and cost closest to the estimation wins.

ESTIMATION IN GROUPS

OBJECTIVES: Students will:

1. Learn estimation skills as related to attributes, fractions, decimals, percentages, and probability.
2. Demonstrate skills in projecting.
3. Develop interpersonal skills by group work.
4. Use math skills in conversion from decimal to fraction to percentages and back.

MATERIALS: 1 box Lucky Charms, Fruit Loops, or any other cereal with various colors and shapes.

SELECT GROUPS: 3-5 in a group. Random selection works best. Select a group leader and have the group select a name.

SCENARIO 1:

Place a pile of cereal on a table. Have each group look at the pile for a short period of time. On a separate piece of paper have the group estimate what fraction/percentage/decimal each color/shape is to the whole. As a class count out the colors and shapes, find the exact fraction/percentage/ decimal of the pile. The group closest wins. Show how charting would make the process easier.

SCENARIO 2:

Give each group a small pile of cereal. **Without counting,** have each group estimate the fraction/percent/decimal of colors and shapes. Compare with the actual figures. Which group came closest? Which had the most colors/shapes? What process was used?

ESTIMATION IN GROUPS
(CEREAL CONT.)

OBJECTIVES: Students will: 1. Demonstrate skills in graphing and proportion/ratio.

SCENARIO 3:

Give each group a pile of cereal. Have the group indicate the fraction/percentage/decimals of each shape/color in graph form. Encourage as many types of graphs as possible. Chart,line graph, pie chart, bar graph, pictograph. The group with the most accurate and varied wins.

SCENARIO 4:

Give each group a pile of cereal in two colors or shapes. Have each group arrive at a proportion/ratio of one color or shape to the other. On a sheet of paper have each group write an answer to the questions the teacher asks of all the groups. Questions should deal with the ratio if a certain number of colors were added or subtracted. What would the new number be? Estimate, then compute by cross multiplication. Stress that once the ratio is established it will not change just the numbers. Have each group member ask the questions, or one group asking another.

ESTIMATION: Multiplying Decimals

Estimation is an essential skill to use when multiplying decimals. A lot of students are unsure or make mistakes in placing the decimal point. When multiplying with mixed decimals, the student should always multiply the whole numbers together to get the estimated answer and also the approximate decimal placement.

EXAMPLE: Bill unloaded 14 boxes that each weigh 2.1 pounds. How many pounds do the boxes weigh altogether?

STEP 1 Estimate first.	STEP 2 Line numbers up at right	STEP 3 Multiply as with whole numbers	STEP 4 Count the digits following each dec. point in the problem. From the right, count out this same number of decimal places in the answer. Insert dec. pt.
14 ≈ 14 X 2.1 ≈ 2 ≈ 28	14 X 2.1	14 X 2.1 14 280 294	14 X 2.1 1 4 28 0 **29.4 pounds**

0 places
+1 place

By using estimation one knows that the answer is going to be around 28 pounds. I was also sure that when I arrived at the answer of 29.4 pounds that the placement of the decimal point was correct. If this were a multiple choice test I probably would not have to work the problem. The estimation would have been close enough to select the correct answer.

SOLVE THE FOLLOWING PROBLEMS BY ESTIMATION:
Check your results with your calculator.

1.) 11.2 X 3.4	2.) 100.4 X 9.1	3.) 9.9 X 6.1	4.) 20.997 X 3.11
5.) $11.01 X 6.19	6.) 89 X 10.2	7.) 3.9 X 4.1	8.) 12.3 X 2.1
9.) 6.9 X 3.1	10.) 199.8 X 1.99	11.) 9.78 X 3.97	12.) $ 19.89 X 4.76

TITLE: Planning a Budget/ Part 1 of 3, Calculating a Monthly Budget Income.

OBJECTIVES: Students will understand the benefits of keeping a budget and will understand required math.

MATERIALS LIST: Worksheets, lesson notes, calculators if desired.

TARGET AUDIENCE: All ABLE 5+ Math

INSTRUCTIONAL GROUP SIZE: Small

ACTIVITY DESCRIPTION:
1. Discussing a budget.
2. Discussing a paycheck.
3. Calculating monthly income.

III. Writing a Budget

A. Vocab.
1 estimate - to guess. you can estimate the cost of an item.
2. luxuries - things you want but can live without.
3. necessities - things you must have
4. installment payments - bills that are paid in parts
5. upkeep - the cost of keeping something maintained

B. How
1. add up all your expenses
a. list necessities
b. list luxuries
c. include installment payments
d. include upkeep like keeping your car in good shape
e. remember both fixed and flexible expenses
f. out-of-pocket expenses - both luxuries and necessities
1. pocket change
2. cigarettes
3. coffee
4. pop
5. bus fare
6. lunch

C. When all expenses are subtracted from income, money should be left over.

D. Complete worksheet luxuries/necessities

E. Keeping a record of expenses - how?
1.Keep an actual record of all money spent the first month. Prepare a budget using this information the second month.

2. There are expense forms which can be purchased, or make an individual one based on attached.

F. Complete worksheets

Luxuries or Necessities?

You may spend your pocket change on some of the following items. What items do you really need? Put an L for luxuries or an N for necessities.

About how often do you buy these items in a month?

Estimate the cost of each item. Multiply that by the number you buy each month to get the total spent on each item per month.

	L OR N	COST	AMOUNT BOUGHT	TOTAL SPENT
BUSFARE				
GUM				
CIGARETTES				
CANDY				
POP				
PIZZA				
BEER				
WINE				
ICE CREAM				
COFFEE				
CDs				
TAPES				
MAKEUP				
MOVIES				
BOOKS				
SCHOOL SUPPLIES				
SPORTS EVENTS				
BARS NIGHTCLUBS				

MONTHLY BUDGET FORM

Income

Take home pay _____

Social Security/Other benefits _____

Other income _____

Total income _____

Monthly Expenses

Fixed

Rent/Mortgage _____

Property tax _____

Insurance _____

Utilities _____

Installment payments _____

Car lease/payment _____

Transportation _____

Other _____

Total fixed _____

Monthly Expenses

Flexible

Groceries _____

Eating out/ordered in meals _____

Eating out snacks _____

House repairs _____

gasoline _____

car repairs _____

Clothing _____

Medical bills _____

Prescriptions _____

Cosmetics hair cuts _____

Laundry _____

School supplies _____

Newspapers _____

Movies/videos _____

Casettes/CDs _____

Recreation _____

Phone _____

Other _____

Total flexible _____

Set Aside Money

Savings _____

Contributions _____

Emergencies _____

Total Set Aside _____

Total of all Expenses _____

MONTHLY BUDGET FORM

Complete the Monthly Budget Form using the income of Sue and Dave Smith and the following information. Sue and Dave have excellent health benefits and average $5.00 per month for out of pocket medical expenses.

Smith's rent	$300.00
Car insurance	$50.00
All utilities	$75.00
Phone	$30.00
Groceries	$200.00
Gasoline	$50.00
Clothing	$20.00
Sundries	$15.00
Laundrymat	$25.00
Movie Rental	$5.00
Eating out	$25.00

Sue and Dave try and save $50.00 per month.
They give $50.00 per month to their church.

Using the Smith's monthly budget form and monthly income sheet, calculate the following.

1. Do the Smiths have any money left over at the end of the month? If so how much?

2. What percentage of their total income do they spend on fixed expenses?

3. If the Smiths were to quit eating out, how much money would they save?

4. What is the ratio between money saved per month and total money spent?

5. If the Smiths want to save 10% of their income per month, how much would they have to save?

TITLE: Planning a Budget/ Part 2 of 3, Completing a Monthly Budget Form.

OBJECTIVES: Students will understand the benefits of keeping a budget and will understand required math.

MATERIALS LIST: Worksheets, lesson notes, calculator if desired.

TARGET AUDIENCE: All ABLE 5+ Math

INSTRUCTIONAL GROUP SIZE: Small

ACTIVITY DESCRIPTION:
1. Determining differences between luxuries/ necessities.
2. Writing a monthly budget form.
3. Applicable Math- percentages, ratios, fractions.

Dave works at a local factory. His gross pay is $800.00 permonth

His net pay is $623.00 per month. How will he pay for the following

items? Mark G for gross pay and N for net pay.

Mortgage_____

Social Securtiy tax_____

Union Dues_____

Groceries_____

State Income tax_____

Car payment_____

Pension_____

Federal income tax_____

Entertainment_____

Clothes_____

I Why have a Budget?

A. Vocab

1. Budget - a spending plan
2. Expenses - reasons for spending money, name of money you spend
3. Fixed Expenses - expenses that stay the same every month. Money you must spend in a certain amount.
4. Flexible Expenses - expenses that change from month to month.
5. Income - money you earn or receive

B. Dicussion

1. Why have a budget? To manage money
   a. helps you live as well as possible on the money you have
   b. smarter than having no plan
   c. lets you see where and how you spend your money
   d. lets you save for future bills
   e. lets you avoid problems immediately after payday
   f. lets you compare your income to expenses, to better use your money

C. How to prepare a budget

1. Figure income
2. List expenses
3. Add fixed and flexible expenses
4. Subtract expense from income
   a. if money is left over, good
   b. if money is not left over, change budget

II Paycheck

A. Discussion / Vocab.

1. Deductions examples:
   a. social security - money saved until you are a senior citizen or when you become disabled
   b. federal withholding tax - money to the federal government
   c. state withholding tax - money to the state of Ohio
   d. Hospitalization or other insurances
   e. pension/retirement
   f. union dues
   g. hold or leins
2. Gross income
   a. amount earned before deductions are subtracted
   b. when you apply for a job, the pay is listed as gross income
3. Net income
   a. amount earned after deductions
   b. take home pay

B. Pay check handouts

1. Gross pay--here called gross earnings is $800.00
2. Tax description
   a. Discuss what each is
3. Discuss year to date fed. withholding etc.
4. Complete worksheets

1. What is the total amount of taxes deducted?_____

2. What is the net pay?_____

3. The deductions are what percent of gross pay?_____

4. The net pay is what percent of gross pay?_____

5. What percent of Y.T.D. gross pay are the following:
   a. YTD OASDI_____
   b. YTD HI_____
   c. YTD FED W/H_____
   d. YTD ST W/H _____
   e. YTD LOCAL_____

6. What percent of Y.T.D. gross pay is the total of the above?_____

Employee Name			Social Security Number			Fed Ex	St Ex	Gross Pay	Check Date	Check No	Net Pay
								800.00		4036134	
Earnings Desc	**Timecard No**	**Customer Name**	**W E Date**	**Hours**	**Rate**	**Gross Earn**		**Ded Desc**	**Ded Amt**	**Tax Desc**	**Tax Amt**
Reg	1417229700					800.00				FEDOASDI/Dis FEDOASDI Med FEDWithholdng OHWithholding 12868Withholdng	49.60 11.60 79.40 27.63 8.00

	YTD FICA OASDI	YTD FICA HI	YTD Fed W/H	YTD St W/H	YTD Loc	YTD Gross Pay	Accumulated Hrs
	317.44	74.24	459.80	163.59	51.20	5,120.00	

TITLE: Planning a Budget/ Part 3 of 3, Goal Setting

OBJECTIVES: Students will understand the benefits of keeping a budget.

MATERIALS LIST: Lesson notes, worksheets

TARGET AUDIENCE: All ABLE

INSTRUCTIONAL GROUP SIZE: Small

ESTIMATED TIME: 1 Hour

ACTIVITY DESCRIPTION:
1. Discussion of goal setting.
2. Worksheets on individual goals.

IV. Budget Goal Setting
   A, Vocab.
      1. Goal - something you want and try to get
      2. Need - something you must have
      3. Want - something for which you wish or desire

   B. Discussion
      1. a budget can help you pay for the things you need and save for the things you want.
      2. different people have different needs and wants.
         a. if a person doesn't have a winter coat, this is a need
         b. if a person desires a winter coat for style, this is a want
      3. it is important to know the difference between needs and wants, because you must pay for your needs before your wants
      4. but knowing your wants will help you set goals
         a. wants can become goals
         b. money can be saved if goals are set
      5. make aplan to get things you want
         a. set a date for youe goals
         b.divide goals
            1. present goals - things wanted soon
            2.near goals - things you want within the year
            3. future goals - things that are far off but that you need to save for now--retirement, college, home.

   C. Complete worksheets

NEEDS OR WANTS

List the following items as needs or wants.

Cigarettes
Stereos
Medical care
Pop
Movie tickets
Food
CDS
Video rentals
Clothing
Telephone
Preschool
Transportation
TV
New clothes
Baby sitter

NEEDS (I MUST HAVE)	WANTS (I WOULD LIKE TO HAVE)

GOALS

	Cost	Monthly Savings	When Can I Buy?
Present Goals			
Near Goals			
Future Goals			

TITLE: Shopping for Clothing and Housewares

OBJECTIVES: Adding, subtracting, multiplying, dividing, and interchanging fractions, decimals, and percents; Estimating and Rounding; Computing sales tax,; compute discounts; using shortcuts and mental math while shopping.

MATERIALS LIST: Handouts and local discounts or department store advertisements.

TARGET AUDIENCE: Multilevel GED or ABE

INSTRUCTIONAL GROUP SIZE: Large, Small, Individual

ESTIMATED TIME: ½ to 1 hour per handout. Optional- Sales tax chart with local sales tax.

ACTIVITY DESCRIPTION : Some instruction and prior knowledge of fractions, decimals, and percents needed. Discuss advertisements and how they encourage shoppers to come to their store. Discuss value of reading carefully to see what limits and dates apply. Discuss comparison shopping. Discuss tax rate chart. Easiest handout is "Estimating When Shopping." Work in groups or individually. Use other handouts at following sessions as desired.

RESOURCES/SOURCES USED: Essential Math for Life, Glencoe, books 2, 3, 8; Connections, Steck-Vaughn; Lifeskills: Developing Consumer Confidence, Contemporary Ch. 3.

Estimating When Shopping

BOXES $5.29 LARGE HANGING PLANT $15.99
BASKET $7.99 FRAME $6.49 WATERING CAN $2.79
FLOWERS $4.19 HOUSEPLANT $.99

1. Which 2 items cost less than $4.00?

2. Which 2 items cost about $5.00?

3. Which 2 items cost about $7.00?

4. If you have $10.00, can you buy the basket and 3 houseplants?

5. To the nearest dollar, estimate how much the boxes, the frame, and the hanging basket will be.

6. What would be some reasons that estimating is a useful skill?

7. In what shopping situations do you feel estimating would be helpful?

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Sales Tax

Sales tax is applied to some things we buy. States can decide the amount of sales tax and the items which will have the tax applied. This money is used by the state for such things as police and highway patrol, the repair and maintenance of roads and highways, and education. Local communities can add a small amount to the tax for local projects. Sales taxes are figured in percentages and added to the purchase price. The store is required to turn the money over to the state.

Step 1: Multiply the price by the rate of the tax.

$5.85 (original price)
x .05 (rate of tax--5%)
$.2925 (tax)

Step 2: Add the tax to the original price.

$5.85 (original price)
+ .30 (tax)
$6.15 (total price including tax)

$. 2925 = .30 (State sales tax is always rounded up.)

****

Find the sales tax and the total price including tax.

Original price	Sales Tax	Amount of Tax	Total Price
Shoes, $55.00	6%		
Shirt, $20.00	6%		
Picture frame, $7.95	6%		
Blanket, $31.95	6%		
Frying pan, $15.49	6%		
Hose, $10.00	6.5%		
Rake, $8.99	6.5%		
Lamp, $25.00	6.5%		
Jacket, $59.99	6.5%		
Car, $14,550	6.5%		

What might be an advantage to shopping for a car in a different state or county?

Figuring Sale Prices

Shopping for items on sale is a great way to save money. When you are looking at the discount being offered, it is important to be able to figure how much will be saved and how much the item will cost with the discount.

Example: A coat regularly sells for $79.00 This week it is on sale for 15% off.
1) How much can you save by buying the coat on sale? $11.85
2) What is the new sale price? $67.15

The following items are on sale for ***25%*** off the regular price. Find the amount saved and the new sale price.

1) Amount saved_____
2) New Price_____

1) Amount saved_____
2) New Price_____

1) Amount saved_____
2) New Price_____

1)Amount saved_____
2) New Price_____

1)Amount saved_____
2) New Price_____

1) Amount saved_____
2) New Price_____

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Shortcut for Computing the Sale Price

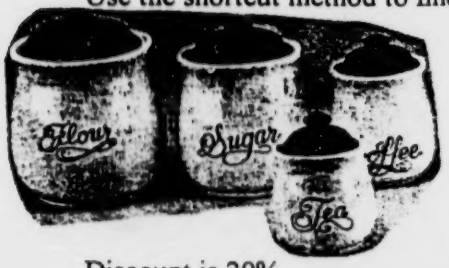
Stores offering a discount will usually express the sale as "25% off" or "1/4 off." This means that to learn what the new price is you might use 2 steps: Compute the discount and then subtract from the original price.

Here is a shortcut: If the discount is "25% off," then the price you will pay will be 75% of the original price. If the discount is "1/4 off," then the price you will pay will be 3/4 of the original price. You simply multiply the original price by 75% or 3/4.

Shortcut: Subtract the percent discount from 100%; then multiply your answer by the original price. Or, subtract the fraction discount from 1; then multiply by the original price.

Example:
Original price is $10.00 Discount is 25%. New price is 75% x $10.00 = $7.50.
Original price is $10.00 Discount is 1/4. New price is 3/4 x $10.00 = $7.50.

Use the shortcut method to find the new price on the following items:



$25.00

Discount is 20% _____

Discount is 40% _____

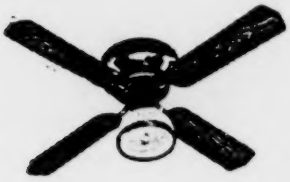
Discount is 75% _____

$7.99

Discount is 33 1/3% _____

Discount is 35% _____

Discount is 15% _____



$32.99

Discount is 1/4 _____

Discount is 1/5 _____

Discount is 3/4 _____

$18.00

Discount is 1/3 _____

Discount is 2/3 _____

Discount is 1/8 _____

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Shortcuts with Percents and Fractions

Some problems can be solved more than one way. Thinking about the problem for a minute might allow you to find a shortcut for solving the problem. Sometimes it may help to think of a fraction instead of a percent, or vice versa. Sometimes a quick mental step will eliminate one of the math steps needed to be done on paper.

Try some of these:

1. Forty percent of the pie has already been eaten. If the pie had been cut in fifths, how many pieces are left? (Hint: change forty percent to 40/100, or 2/5. 2 pieces have been eaten, and three are left.)

2. Margie sees a sign in the coat department that reads 25% off. Estimate her savings on a coat that is regularly $99.99. (Hint: Round off the price to $100. Think: 25% is the same as !/4. 1/4 of 100 is 25. The savings should be about $25).

3. The farmer feels about 85% of his crops have been ruined by bad weather. What percent is usable? (Hint: subtract 85 from 100).

4. 22% of the shirts at a store have been sold. What percent is left? (Hint: subtract 22 from 100).

5. 69% of the voters approved the levy. How many of the 3,593 voters did not support the levy? (Hint: subtract 69 from 100, and multiply that number by 3,593).

6. A new lawnmower costs $297.00. If there is a 20% off sale, how much will the mower cost? (Hint: subtract 20 from 100. Multiply that percent by $297.00).

7. The sportswriter has been right 63% of the time on his predictions of the NFL winners each week. If there are 20 games each week, how many does he predict incorrectly? Round your answer to the nearest whole number. (Hint: subtract _____).

8. The library has 87,035 books. 43% of them were purchased before 1980. How many have been bought from 1980 to the present?

9. The teacher has finished grading about 50% of her students' tests. She has 23 students. How many tests has she finished grading? (Hint: would a fraction be easier?)

10. James is buying a new TV for $299.00. He wants to make sure he has enough money for the sales tax. He knows the tax rate is 6%. Which of the following is the approximate amount James will need for tax:

1) $10 2) $11 3) $17 4) $18 5) $19

(Think: 6% of $100 is 6. 299 is almost 300. He will need $6 for each $100 for the tax. 6 + 6 + 6 = 18. He needs $18.00 for tax).

By taking a few seconds to think about the problem, you may save yourself some time and effort!

Shopping in the Housewares Department

Small group work: Divide class into 2 or 3 small groups.

Materials: 1 copy of the bottom half of this page for each group.
Optional: weekly flyers or newspaper advertisements from area merchants that feature general household merchandise.

Have the students work in groups to make a list. After 15 minutes, compare lists.

You are moving into your first apartment, and you need to do some shopping. Your apartment has all of the necessary appliances, and your food will be purchased at a later date. You have brought some used furniture, a vacuum cleaner, dishes and towels.

What you need to do now is to purchase all the miscellaneous household items that you will need. You have budgeted $100 for these items.

With your group, make a list of items and estimated costs that you should plan to buy to keep your apartment clean and orderly.

Small Group Cooperative Problem Solving

Andrea, Bill, Carlos, and Donna go to the mall. Each has things in mind to purchase. They plan to meet at the food court at 3:30 to have a soft drink. Who has enough money left to treat for the soft drinks?

Clue 1: At the start, Andrea has $50. Bill has $35, Carlos has $35, and Donna has $15.

Andrea, Bill, Carlos, and Donna go to the mall. Each has things in mind to purchase. They plan to meet at the food court at 3:30 to have a soft drink. Who has enough money left to treat for the soft drinks?

Clue 2: Andrea finds the shoes she needs at Sports, Inc. for 30% off the regular price of $65.99. Tax is 5.5%.

Andrea, Bill, Carlos, and Donna go to the mall. Each has things in mind to purchase. They plan to meet at the food court at 3:30 to have a soft drink. Who has enough money left to treat for the soft drinks?

Clue 3: Bill needs a gift for his mother's birthday. He decides to purchase a sweater at King's that is 1/4 off the regular price of $39.99. Tax is 5.5%. Gift wrapping is free, but he needs to use $2 for a card.

Andrea, Bill, Carlos, and Donna go to the mall. Each has things in mind to purchase. They plan to meet at the food court at 3:30 to have a soft drink. Who has enough money left to treat for the soft drinks?

Clue 4: Carlos buys both of his 2 sons T-shirts that are $9.99 each, and a book for himself that is $4.99. Tax is 5.5%.

Andrea, Bill, Carlos, and Donna go to the mall. Each has things in mind to purchase. They plan to meet at the food court at 3:30 to have a soft drink. Who has enough money left to treat for the soft drinks?

Clue 5: Donna finds a great bargain: Bed pillows at 2 for $26.99. However, she only needs 1 pillow. Tax is 5.5%.

Directions: Cut these clue cards apart. Separate class into groups. Distribute cards. Have group members do math computations to find group answer.

Answers: Andrea spends $48.73, Bill spends $33.64, Carlos spends $26.35, and Donna spends $14.25.

Carlos has money left to treat for soft drinks.

TITLE: Major Purchase and Shopping by Mail

OBJECTIVES: Multiplying percents; using proportions; changing fractions to percents and percents to fractions; computing installment plan buying; learn to fill out catalog order forms; computing percents saved on sale items and comparing sales at various stores; and learning additional ways to save money.

MATERIALS LIST: Handouts, catalogs, sales, receipts, and newspaper advertisements.

TARGET AUDIENCE: Multilevel ABE and GED

INSTRUCTIONAL GROUP SIZE: Large, Small, Individual

ESTIMATED TIME: 1 hour for each handout.

ACTIVITY DESCRIPTION: Some introduction and prior knowledge of percents, fractions, and decimals needed. Explain installment plans. Use handout "Installment Plan Buying" for practice and additional discussion. Use catalogs and copies of "Mail Order Shopping." Discuss benefits and time saving features of mail order and disadvantages of shipping costs and not liking merchandise when it arrives! Teach proportions with handouts and additional example from newspapers. As a wrap-up to unit on shopping, discuss any other aspects not already covered. Use handout "Other Shopping Ideas."

RESOURCES/SOURCES USED: Life Skills Mathematics, AGS, Ch.13; Lifeskills: Developing Consumer Competence, Contemporary Ch. 3; Essential Mathematics for Life, Books 3,7,8, Glencoe.

Installment Plan Buying

Some stores will offer you the choice of buying large items on the installment plan. This means they will ask for a down payment, and then a scheduled number of payments. The plan might read like this:

Mattress and box springs for $499.00. All you need is $50.00 down, and 10 monthly payments of $50.00 each.

As a consumer, it is helpful to figure out how much you are paying in total. The store will usually be charging you an additional amount, called a finance charge. The store owner would like to make an additional profit since he will be giving you the product long before it is paid for. In the example above, your total cost for the mattress and box springs will be $550.00: $50.00 + (10 x $50.00 or $500.00) = $550.00.

Solve the following problems.

1. Sally wants to buy a color TV and VCR. The advertised cost is $699.00. The terms are $100.00 down & 12 equal payments of $60.00. What is the total cost?

2. Jim found a great new winter jacket for $119.00. He can put 25% down and pay 3 monthly payments of $35.00. How much will he pay for the jacket?

3. Tomika needs a new computer for the business she is starting. With all the accessories, the price adds up to $2,800. She found a store that is offering a plan of 35% down and $165 a month for a year. She cannot afford to pay for the computer in cash.
   a) What is the total cost of the computer?
   b) What advantages would there be in agreeing to this plan?

4. A new minivan costs $18, 449. The dealer will accept a down payment of $3000.00, and 5 years of monthly payments of $325.00. With this plan, what will be the total amount paid for the minivan?

There definitely are some times when using the installment plan is necessary or the only way to make a purchase. However, there are some times when it should not be used.

What are advantages to using this plan?

What are disadvantages to using this plan?

What are some specific items are helpful to purchase this way?

What are some items to avoid purchasing this way, and why?

Mail Order Shopping

When ordering by mail, it is important to be as neat and accurate as possible on the order form. The price column must be totaled, tax added when required, delivery costs added, and a grand total computed.

Use a catalog and pick out several items you would like to order. Enter all the required information on the form below. Finish all steps of the order.

Name Address

City, State Zip

Page No.	Name of Item	Catalog Number	Size	Color	How Many	Price for One	Total Price for this Item

Merchandise Total_____

Amount for Delivery_____
(see chart)

Sales Tax @ 6.5%_____

TOTAL _____

Amount for Delivery

Merchandise Total	Delivery Charge
$ .01 to $9.99	$1.50
$10.00 to $19.99	$2.50
$20.00 to $29.99	$3.50
$30.00 to $39.99	$4.50
$40.00 to $49.99	$5.50
$50.00 and over	$6.00

Using Proportions to Find Prices

You may wish to find the price of a smaller or larger number of items than the advertised price reflects. You can do this with a proportion.

Example: The cost of green peppers is 2 for $ .85. How much does 1 cost?

Step 1--Write a proportion. $\frac{2}{\$.85} = \frac{1}{n}$

Step 2--Solve for n. Multiply the 2 numbers that are opposite each other, and divide by the third number.

$\frac{2}{\$.85} = \frac{1}{n}$ $\quad \frac{\$.85 \times 1}{2} = \$.425$

Step 3 Round up to the next penny if there is a remainder:

$\$.425 = \$.43$

One green pepper costs $.43 cents.

Find the cost of the following items using proportion.

1. 10 pounds of potatoes @ 5 pounds for $1.89 _____
2. 3 cans of tomato sauce @ 4 cans for $1.19 _____
3. 3 pounds of grapes @ 2 pounds for $1.65 _____
4. 6 jars of baby food @ 4 jars for $!.99 _____
5. 1 bag of peat moss @ 3 bags for $5.00 _____
6. 1 dozen tulip bulbs @ 20 for $3.79 _____
7. 2 geraniums @ 5 for $7.99 _____
8. 1/2 pound of nails @ $3.29 a pound _____
9. 23 inches of trim board @ $.59 a foot _____
10. 15 inches of lace @ $2.99 a yard _____

More Uses of Proportion and Percent

There are many ways to use proportions and percents to solve problems. By filling in a formula with the 3 known figures, the fourth can be found.

Example: A CD player is marked down from $300.00 to $240.00. What is the percent of the discount?

Step 1--Think: if the new price is $240.00, the discount = $60.00 (300 - 240 = 60)

Step 2 $\frac{\text{part}}{\text{whole}} = \frac{\%}{100}$ $\frac{\$60.00}{\$300.00} = \frac{\%}{100}$ $\frac{60 \times 100}{300} = 20$

The discount amount is 20%

Example: Tomas has returned home to live with his mother for a while. She asks him to give her 75% of his weekly earnings for room and board. If Tomas earns $122.50 per week, how much will he owe to his mother?

$\frac{\text{part}}{\text{whole}} = \frac{\%}{100}$ $\frac{?}{\$122.50} = \frac{75\%}{100}$ $\frac{\$122.50 \times 75}{100} = \$91.8750$ or $91.88

****

Try some yourself! Use the formula above. Use your calculator!

1. A new bike is 35% off the original price. If the original price is $189.95, what is the savings?

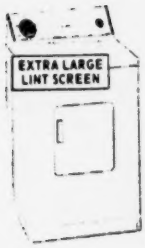
2. Sweaters at your favorite store are marked down from $39.95 to $26.95. What is the percent of discount?

3. This week carpet is advertised at 28% off. Last week the carpet you wanted was marked down from $19.99 a square yard to $16.99 a square yard. Which week has the better sale?

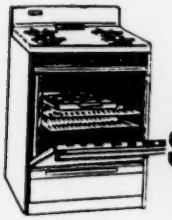
4. The new hardware store has been offering a coupon for a free pair or work gloves with any purchase. The owner would like to know what percent of his customers this month came in and used the coupon.. If the cash register recorded 4,785 customer sales and 1,050 coupons were used, what percent of the customers used the coupon?

5. Some tapes you are interested in are on a clearance table. The price is 3/$10.00. If the original price for each tape was $8.99, what percent is the discount?

On Sale!



A.
Electric Dryer
$177



B.
$197

C.
Refrigerator
$377

D. **$89.86**

E.
$129

Sometimes stores will be having a sale and will advertise that some items or all items are discounted. However, they may not change the pricetags on the items; instead, the sign might tell you that "the register will scan the correct price."

For items A-E above, compute the amount of money to be taken off the original price if the sign says:

1. 10% off these appliances

A._____ B._____ C._____ D._____ E._____

2. 15% off today!

A._____ B._____ C._____ D._____ E._____

3. 30% off this weekend only!

A._____ B._____ C._____ D._____ E._____

Buying With A Discount

Store discounts can be expressed in percents or fractions. When comparing discount prices, it is important to be able to find out which discount will save you the most money.

Sherman's and Major's are two appliance stores in the local area. Both sell the same brands of appliances. Circle the store offering the better discount:

1. Refrigerators	35% off at Sherman's	1/2 off at Major's
2. Washing machines	33 1/3% off at Sherman's	1/4 off at Major's
3. TVs	10% off at Sherman's	1/5 off at Major's
4. Cd players	60% off at Sherman's	2/3 off at Major's

To change from a percent to a fraction, drop the decimal point and put the number over 100. Reduce if possible.

$35\% = \frac{35}{100} = \frac{7}{20}$

To change from a fraction to a percent, divide the denominator into the numerator. Move the decimal point over 2 spaces to the right.

$\frac{1}{6} = .16\ 4/6 = .16\ 2/3 = 16\ 2/3\%$

$6\overline{)1.00}$

Do the following conversions. Then use the fraction or the percent to find the sale price.

Appliance	Fraction Discount	Percent Discount	Original Price	Sale Price
Camera	1/3		$ 50.00	$
Toaster		25%	$ 29.00	$
Oven	1/8		$499.00	$
VCR	2/3		$200.00	$
Headphones		15%	$ 35.00	$
Video Game	2/5		$109.00	$

Other Shopping Ideas

1. Make time to do comparison shopping whenever possible. If only one store advertises the item you want, call other stores and ask over the telephone if the item is available and what the price will be. Sometimes a store will match a competitor's price.

2. Do comparison shopping frequently when you buy groceries. Find out which store has the better prices on items you use weekly. Buy on sale whenever you can, and stock up on extra item while they are on sale.

3. Take a small calculator with you when you shop.

4. If you have to buy items on the installment plan, figure out how much additional money you will be spending. Think about delaying the purchase until you have the cash whenever possible.

5. Practice rounding and estimating when you are buying a small number of items. See how close you can come to the actual price rung up on the cash register.

6. Check your sales receipts often. Always check on larger items. Stores do occasionally make mistakes. Sometimes they forget to enter a sale price into the computer, and the register rings up the full price. If they make a mistake, call it to their attention. You will save money, and so will the customers after you!

7. Try some generic brands. You may find they are completely acceptable on most items.

8. Plan ahead for major purchases, birthday and holiday shopping. Try to buy some items in advance on sale. Or make purchases during clearance sales and save them for the next occasion.

9. If you must buy a larger quantity than you need of an item, think of ways to use the extra. Double the recipe and freeze some. Give the extra amount to your neighbor. Look for another recipe that also uses that item.

10. Using MATH can save you money!

TITLE: Grocery Shopping

OBJECTIVES: Practice adding, subtracting, multiplying, and dividing decimals; reducing and multiplying fractions; comparing fractions and decimals; computing total cost of food items; computing change; computing unit costs; computing costs with coupons and sales; comparing costs at different stores; changing fractions to percents, and cooperative learning.

MATERIALS LIST: Handouts and local grocery flyers, food products that come in various sizes.

TARGET AUDIENCE: ABE and GED-Multilevel

INSTRUCTIONAL GROUP SIZE: Large, Small, Individual

ESTIMATED TIME: ½ to 1 hour per handout.

ACTIVITY DESCRIPTION: Some instruction or prior knowledge of decimals and fractions needed. Distribute grocery store flyers to begin first day of discussion of grocery store shopping. Discuss bar codes on products and price locations, such as shelf edges, stamped price tags, and signs. Discuss general public's confusion on comparison shopping. Discuss coupons and rebates. Easiest hand out should be "Shopping at Different Stores." Work in groups or individually. Use other handouts at following sessions as desired.

RESOURCES/SOURCES USED: Life Skills Mathematics, A.G.S. Inc. Ch. 8; Essential Math for Life, Glencoe, books 2,7,8; Math Matters for Adults, Steck-Vaugh, Fractions and Decimals, Math in the Supermarket, Educational Design Inc.

SMITTY'S

Cranberry Drink, 64 oz.	$2.99	Happy Valley Salad Dressings	$.99
Broccoli, per bunch	$ .79	Flora's Frozen Vegetables	$.88
Macaroni & Cheese	$ .39	Raz Pineapple Chunks,20 oz	$.79
All-Purpose Flour	$ .69		

****

Connor's

Macaroni & Cheese	$ .44	Flora's Frozen Vegetables	$.99
Cranberry Drink,64oz.	$2.99	Broccoli, per bunch	$.88
Raz Pineapple Chunks	$ .69	All-Purpose Flour	$.99
Happy Valley Salad Dressings	$1.99		

****

Shane's

All-Purpose Flour	$ .88	Cranberry Drink, 64 oz.	2/$5.00
Happy Valley Dressings	$1.69	Broccoli, per bunch	$ .68
Flora's Frozen Vegetables	$ .79	Raz Pineapple Chunks, 20 oz	$ .79
Macaroni & Cheese	$ .69		

****

1. Which of the three stores has the best total price for these 7 items?_____.
What would be the change received from $20.00?_____.

2. Sharon needs to buy 2 boxes of macaroni & cheese, 1 bottle of cranberry drink, and 1 bunch of broccoli. What would be the best total price for these 3 items?_____store___.
What would be the change received from $10.00?_____.

3. Sam would like 3 bags of frozen vegetables for his homemade soup. He also needs a bag of flour. Which store would have the best total price?_____price_____.
What would be the change received from $5.00?_____.

4. You wish to purchase 2 bottles of salad dressing and 3 cans of pineapple chunks.
Where should you shop for the best total price?_____price_____.
What would be the change from $20.00?_____.

5. What other factors are important to consider besides price when deciding which store to do your grocery shopping?

_____

_____.

Comparing Prices

(1.) Flavor-rite cola $2.99
12 pk. 12 oz. cans

(2.) 12 oz. cans, 12 pack $1.99
Flavor-rite cola
limit 1
additional pks. $3.29

(3.) /$4.99 with this coupon
Flavor-rite cola
12 pk. 12 oz. cans

(4.) Flavor-rite cola
24 pk. 12 oz. cans
$5.99

(5.) 12 pk. 12 oz. cans
Flavor-rite cola $2.49
limit 1. each additional
purchase $2.99

1. What is the price of 24 cans of each of these special offers?

1._____ 2._____ 3._____ 4. _____ 5._____

2. Which offer is the least expensive? _____ the most expensive?_____

3. If a $.50 coupon is used, which is the least expensive?_____
If the coupon is doubled, which is the least expensive? _____

4. If 2 $.50 coupons can be used, one for each 12 pack, which would be the best offer?_____

5. If only 12 cans are needed, which is the best offer?_____

6. If many 12 packs are needed, such as for a party, what would be some ways to save the most money?

_____

Fruit Salad

The produce department of grocery stores contains fresh fruits and vegetables. Items can be sold by the pound, by the bunch, or by the piece. Which fruits and vegetables have you seen sold by the pound?_____ _____. Which are sold by the bunch?_____. Which are sold by the piece?_____.

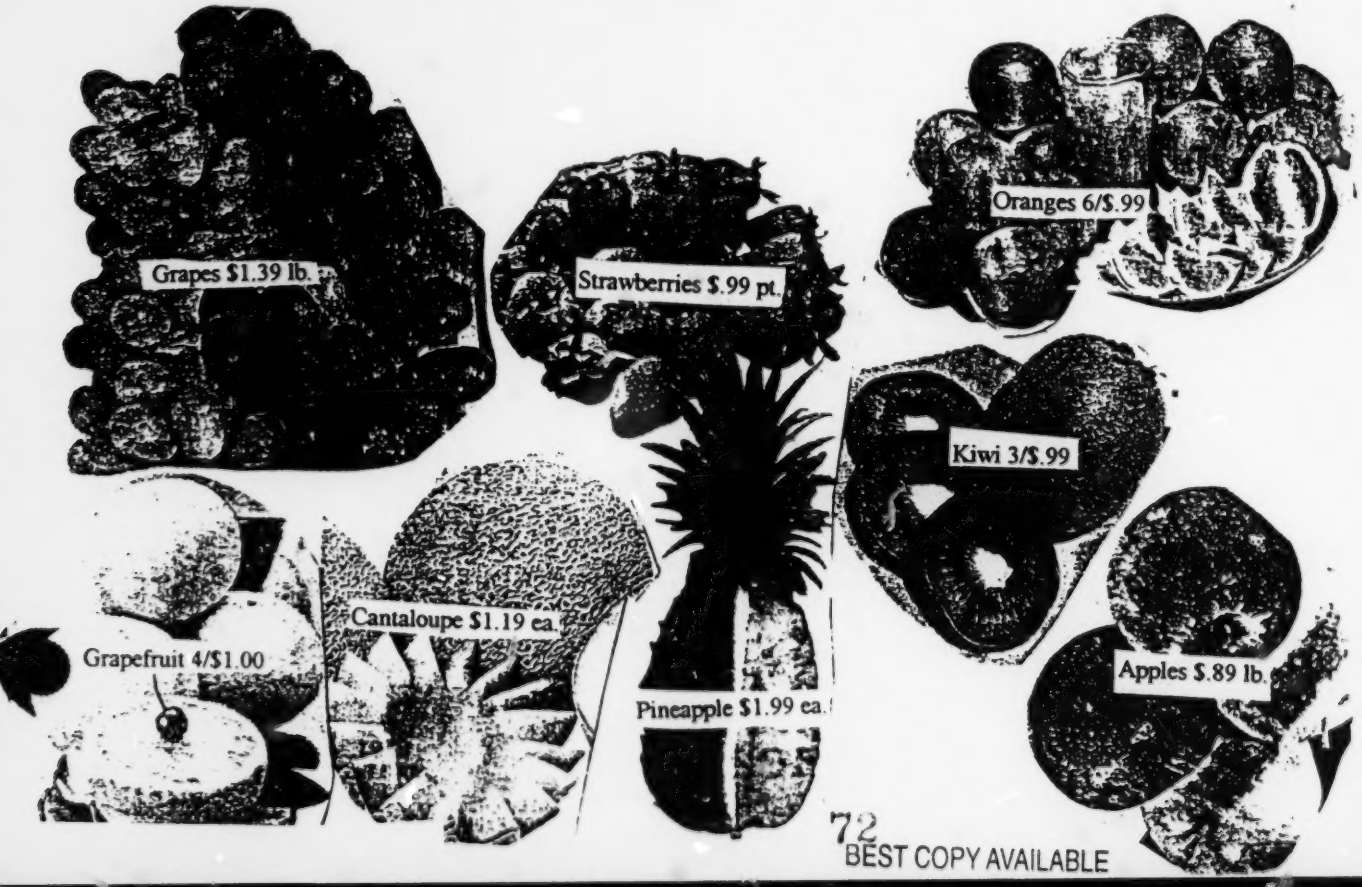
Many items may be prepackaged by the wholesaler before they come to your store, such as radishes, carrots, or apples. What are some fruits or vegetables that are packaged by the produce department employees? _____ _____.

Most items can be bought in very small quantities. If you don't need or won't use 6 tomatoes wrapped in cellophane, ask the produce department worker to open the package for you. Buy the amount you will use during the next few days.

If grapefruit are priced at 4/$1.00, and you wish to purchase 1 grapefruit, how much will you pay? _____.

****

Pick 4 fruits from those shown to make a fruit salad. Try to balance your salad with fruit of different colors and tastes. Try to have about the same amount of each fruit. What will your total cost be?



BEST COPY AVAILABLE

Price Per Ounce/Unit Price

Sometimes stores will have the "price per ounce" listed on the tag on the edge of the shelf, so that it is easy for you to see which size of a product is a better value. If it is not listed, you might want to figure it out for yourself.

Example: Rice cereal 14 oz. is $2.29
20 oz. is $2.99

$14\overline{)2.290}$ .163 or 16 per oz.

$20\overline{)2.990}$ .149 or 15 per oz.

Therefore the 20 oz. size is a better deal.

Figure out some prices per ounce for yourself.

	Small Size	Large Size	Better Deal
Apple Juice	32 oz./$ .79	64 oz./$1.49	_____
Pork Chops	1.5 lb./$2.79	2.5 lb./$4.99	_____
Carrots	1 lb./$ .69	2 lb./$1.35	_____
Potatoes	5 lbs./$1.89	10 lbs./$3.89	_____
Ice Cream	1 qt. (32 oz.)/$1.79	1/2 gal. (64 oz.)/$3.49	_____
Ravioli (canned)	15 oz./$ .89	23 oz./$1.29	_____
Chicken Noodle Soup	10.5 oz./$ .63	26 oz./$1.49	_____
Cocoa Mix	12 oz./$ .99	20 oz./$1.39	_____
Milk	1/2 gal./$ .95	1 gal./$1.89	_____
Bagels	1/$ .35	6/$1.99	_____
Soda Pop	6 12 oz. cans/$1.99	2 liter bottle/$1.29 (67.6 oz.)	_____

Does your grocery store have unit prices listed by each item? Write a paragraph expressing your appreciation to the manager of the store. Be sure to include specific details about the way the unit prices help you as a consumer.

If your grocery store does not have unit prices listed, write a paragraph to the store manager. Explain how the unit prices would help you shop for the best value. Include specific examples.

Staying Within A Budget

Donna is going to have a small party Saturday night with a few friends. Because of her limited budget, she has made a list of food items she would like to be sure to purchase only what is needed at the grocery store. She is looking at the weekly flyer for Jones' Grocery Store to see how much her items will cost.

Donna's list	Jones' weekly flyer		Donna's cost
1/2 lb. sliced turkey	turkey--	$4.99 lb.	_____
3/4 lb. sliced ham	ham--	$3.99 lb.	_____
1 1/2 lbs. muenster cheese	muenster cheese--	$4.39 lb.	_____
2 lbs. potato salad	potato salad--	$1.59 lb.	_____
8 sub buns (hint: 8 is what part of a dozen?)	sub buns--	$2.29 doz.	_____
1 bag chips	chips--	2/$4.99	_____
2 bags pretzels	pretzels--	$ .99	_____
12 cans of pop	pop--	6/$1.99	_____

Figure out the cost of the items on Donna's grocery list.

_____
Total Cost

Donna would also like to buy a small cake to celebrate one guest's birthday. Small cakes are $4.00. Donna has $30.00. Will she have enough money for the cake?

Comparing Unit Costs

Be a careful shopper! Advertisements can fool you! The only way to find out which of 2 brands is the least expensive is to use MATH. There are 2 ways to find the answer.

Example:
Smart Value pears are 2 cans for $ .69. Delicious pears are 3 cans for $ .99.
Which is the better value?

Solution #1 Reduce the Fraction

Smart Value $\frac{69 \text{ cost}}{2 \text{ cans}}$ = $ .34 1/2 each

Delicious $\frac{99 \text{ cost}}{3 \text{ cans}}$ = $ .33 each

Solution #2 Division Problem

Smart Value $2\overline{).69}$ .34 1/2 each

6
9
8
1

Delicious $3\overline{)99}$ 33 each

The same 2 ways can be used to figure out which size of a product is a better value:

Your favorite cereal comes in 14 or 26 ounce package. Make a fraction with each size under the cost: $\frac{\text{cost}}{14}$ $\frac{\text{cost}}{26}$ Reduce the fraction to compare cost.

Or make a division problem.. Divide the cost by the number of ounces.

$14\overline{)\text{cost}}$ $26\overline{)\text{cost}}$

Either method will give you the price per ounce.

	Smart Value	Delicious	Which is the better value?
Tissues	3/$2.00	8/$6.00	_____
Bananas	4 lbs./$ .99	3 lbs./$. 68	_____
Yogurt	2/$ .89	$ .42 each	_____
1 loaf bread	$ .65 each	2/$1.29	_____
Cupcakes	6/$1.49	$ .25 each	_____
Cereal	13 oz./$2.29	19 oz./$3.09	_____
Pickles	8 oz./ $1.09	12 oz./$1.49	_____
Milk	1/2 gal./$ .97	1 gal./$1.89	_____

Tossed Salad

Ellen wants to make 3 pounds of her favorite salad. How many ounces of each vegetable will be on her shopping list? Clue 1: Lettuce is 2 times the amount of any other vegetable.	Ellen wants to make 3 pounds of her favorite salad. How many ounces of each vegetable will be on her shopping list? Clue 2: 2/3 of the salad is green.
Ellen wants to make 3 pounds of her favorite salad. How many ounces of each vegetable will be on her shopping list? Clue 3: 1/6 of the salad is cucumbers. (Think of cucumbers as "green").	Ellen wants to make 3 pounds of her favorite salad. How many ounces of each vegetable will be on her shopping list? Clue 4: 1/6 of the salad is orange.
Ellen wants to make 3 pounds of her favorite salad. How many ounces of each vegetable will be on her shopping list? Clue 5: 1/12 of the salad is red.	Ellen wants to make 3 pounds of her favorite salad. How many ounces of each vegetable will be on her shopping list? Clue 6: Cauliflower will be the same amount as tomatoes.
Ellen wants to make 3 pounds of her favorite salad. How many ounces of each vegetable will be on her shopping list? Clue 7: Celery will be the same amount as carrots.	

Directions: Cut these clue cards apart. Separate class into groups. Distribute cards. Have group members do math computations to find group answer.

Answers: Lettuce = 16 oz. Cucumbers = 8 oz. Celery = 8 oz.
Carrots = 8 oz. Tomatoes = 4 oz. Cauliflower = 4 oz.

Vegetable Stir-Fry

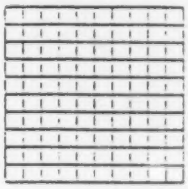
Steve is in the produce department of his favorite grocery store picking out vegetables to make stir-fry for dinner.

Using several different colors of ink, pencil, or marker (or lighter and darker shadings with your pencil) color in the amount he will buy for each variation. You will need to convert the fractions to percents. Try to do some in your head!

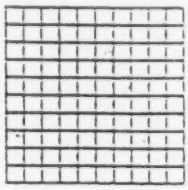
All variations will fill up 100% of the graph.

****

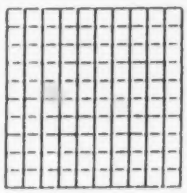
Variation #1 Color:
1/2 for carrots and 1/2 for green beans



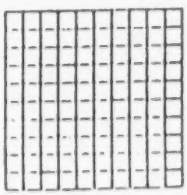
Variation #2 Color:
1/4 for brussel sprouts, 1/2 for celery, and 1/4 for corn



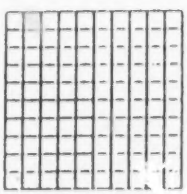
Variation #3 Color:
1/5 for asparagus, 1/5 for potatoes, 2/5 for green beans, and 1/5 for snap peas



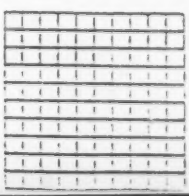
Variation #4 Color:
1/10 for celery, 1/5 for carrots, 3/10 for corn, and 2/5 for onions



CHALLENGE!
Variation # 5 Color:
1/3 for potatoes, 1/3 for snap peas, and 1/3 for asparagus



Variation #6 Color:
1/8 for brussel sprouts, 1/4 for green beans, 1/8 for carrots, and 1/2 for corn



TITLE: Taking The Stress Out Of The Holiday Budget

OBJECTIVES: Allowing students to interact and learn to make good economical as well as nutritional choices when buying groceries for everyday or a holiday meal.

MATERIALS LIST: Food Pyramid; grocery ads; grocery tally
Advanced: grocery coupons

TARGET AUDIENCE: All Levels

INSTRUCTIONAL GROUP SIZE: Small

ESTIMATED TIME : Can be done in one class period or extended over two.

ACTIVITY DESCRIPTION: Students are given a copy of the food pyramid and the nutritional value of each section is explained. After dividing into small groups of 2-4, they are presented with several grocery ads. A budget is determined and a holiday is appointed to each group. Students must then decide what they are going to feed the family buying wisely from the grocery ads. They must have foods from each pyramid category without going over their grocery allowance, and they must buy enough to feed all 8 people. Students then write their menus on the board and need to show what they've bought and how much each item costs. The team coming the closest to serving a nutritional meal without going over their budget is the winner.
Advanced: Follow the same procedure but add coupons (either ones you've saved or homemade) that co-ordinate with your ads. Then tell students that they may deduct the coupon from the item they're buying. To make it more difficult, double coupons up to $1.00. They must be able to show the deductions on the board when they write out their menu.

RESOURCES/SOURCES USED: Grocery ads and manufacturers coupons. "Food Pyramid" from ext. April '93 issue.

TITLE: Holy Cow! Look What We're Eating!

OBJECTIVES: Make students aware of how much our society is eating as well as The nutritional values that could improve their own diet. Also teaching math skills from simple addition through fractions.

MATERIALS LIST: Food Pyramid; What Counts as a Serving? Rate Your Diet; Fast Food menus; Fast Food poster; general info concerning calories.

TARGET AUDIENCE: Information is valuable to all levels. Math is geared to ABLE Students.

INSTRUCTIONAL GROUP SIZE: Individual

ESTIMATED TIME: Over a 20 hr. Week.

ACTIVITY DESCRIPTION:

I. Students are given a copy of the food pyramid and the nutritional value of each section is explained. The hand-out, "What Counts As A Serving" is discussed and the instructor can show samples of a medium apple; ½ cup of rice; 2 oz. Of cheese, etc. Ask students to "Rate Their Diet" on the next hand-out and then by following the pyramid, list all the foods they've eaten on the previous day on the food pyramid.

II. Explain calories and why people gain weight . Show a sample fast food menu for a day. Make up questions for addition; subtraction; multiplication; fractions; etc.

III. Give students the correct amount of calories for a day for a woman or man and allow them to produce their own fast food menu.
Advanced: Write your fast food menu for a day within the correct servings of the food pyramid.

RESOURCES/SOURCES USED: Restaurant Menus/Hand-outs- "Harvest Health at Home" Ext. April, 1993, "Calories In Fast Food" Ohio Dept. of Health.

TITLE: Taking The Stress Out Of The Holiday Budget

OBJECTIVES: Allowing students to interact and learn to make good economical as well as nutritional choices when buying groceries for everyday or a holiday meal.

MATERIALS LIST: Food Pyramid; grocery ads; grocery tally
Advanced: grocery coupons

TARGET AUDIENCE: All Levels

INSTRUCTIONAL GROUP SIZE: Small

ESTIMATED TIME : Can be done in one class period or extended over two.

ACTIVITY DESCRIPTION: Students are given a copy of the food pyramid and the nutritional value of each section is explained. After dividing into small groups of 2-4, they are presented with several grocery ads. A budget is determined and a holiday is appointed to each group. Students must then decide what they are going to feed the family buying wisely from the grocery ads. They must have foods from each pyramid category without going over their grocery allowance, and they must buy enough to feed all 8 people. Students then write their menus on the board and need to show what they've bought and how much each item costs. The team coming the closest to serving a nutritional meal without going over their budget is the winner.
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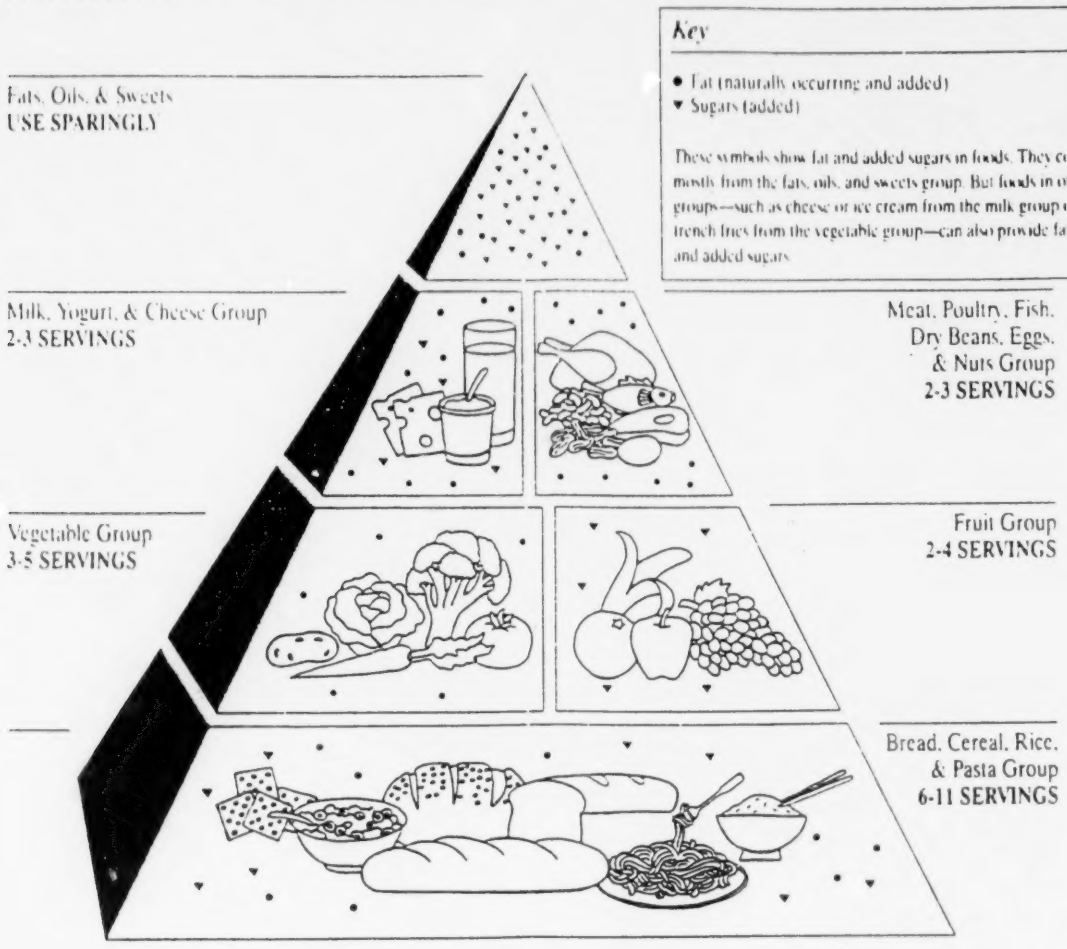
A Look at
The FOOD GUIDE PYRAMID
A Guide to Daily Food Choices


Key
• Fat (naturally occurring and added)
▼ Sugars (added)
These symbols show fat and added sugars in foods. They come mostly from the fats, oils, and sweets group. But foods in other groups—such as cheese or ice cream from the milk group or french fries from the vegetable group—can also provide fat and added sugars.
Fats, Oils, & Sweets
USE SPARINGLY
Milk, Yogurt, & Cheese Group
2-3 SERVINGS
Meat, Poultry, Fish, Dry Beans, Eggs, & Nuts Group
2-3 SERVINGS
Vegetable Group
3-5 SERVINGS
Fruit Group
2-4 SERVINGS
Bread, Cereal, Rice, & Pasta Group
6-11 SERVINGS

HOLY COW ! ! LOOK WHAT WE'RE EATING!

The body uses energy all the time. You use up that energy when you do anything from sleeping to running. Different foods contain different amounts of calories. When a person is idle, they need less calories than one who is very active. You need more calories when you're sick than when you're ill. People gain weight when they eat more calories than their bodies use for energy.

Calories - The energy in food is measured in calories. 3,500 calories per pound.

Nutrition - The foods needed by the body for growth.

In order to lose a pound, one must consume 3,500 less calories. This can be done by cutting back or by burning the calories off through exercise.

What Counts as 1 Serving?

The amount of food that counts as 1 serving is listed below. If you eat a larger portion, count it as more than 1 serving. For example, a dinner portion (1 to 1-1/2 cups) of spaghetti would count as 2 or 3 servings of pasta.

Try to pick the lowest fat choices from the food groups. No specific serving size is given for the fats, oils and sweets group because the message is USE SPARINGLY.

Bread, Cereal, Rice, and Pasta

- 1 slice of bread
- 1 ounce of ready-to-eat cereal
- 1/2 cup of cooked cereal, rice, or pasta

Fruit

- 1 medium apple, banana, orange
- 1/2 cup of chopped, cooked, or canned fruit
- 3/4 cup of fruit juice

Vegetable

- 1 cup of raw leafy vegetables
- 1/2 cup of other vegetables, cooked or chopped raw
- 3/4 cup of vegetable juice

Milk, Yogurt, and Cheese

- 1 cup of milk or yogurt
- 1 1/2 ounces of natural cheese like cheddar
- 2 ounces of process cheese like American

Meat, Poultry, Fish, Dry Beans, Eggs, and Nuts

- 2-3 ounces of cooked lean meat, poultry, or fish
- 1/2 cup of cooked dry beans, 1 egg, or 2 tablespoons of peanut butter **count as 1 ounce** of lean meat

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- 1 slice of bread
- 1 ounce of ready-to-eat cereal
- 1/2 cup of cooked cereal, rice, or pasta

Fruit

- 1 medium apple, banana, orange
- 1/2 cup of chopped, cooked, or canned fruit
- 3/4 cup of fruit juice

Vegetable

- 1 cup of raw leafy vegetables
- 1/2 cup of other vegetables, cooked or chopped raw
- 3/4 cup of vegetable juice

Milk, Yogurt, and Cheese

- 1 cup of milk or yogurt
- 1 1/2 ounces of natural cheese like cheddar
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Rate Your Diet

Mark the box which best describes what you eat. (See page 6 for serving sizes.)

		Always	Sometimes	Never
1	I eat at least 6 servings of bread, cereal, rice, pasta or other foods made from grains every day.	☐	☐	☐
2	I eat at least 2 servings of whole grain foods every day.	☐	☐	☐
3	I eat at least 3 servings of vegetables every day.	☐	☐	☐
4	I eat cooked legumes, like navy and kidney beans, 2 to 3 times a week.	☐	☐	☐
5	I eat a dark green leafy vegetable, like spinach or broccoli, 2 to 3 times a week.	☐	☐	☐
6	I eat at least 2 servings of fruit every day.	☐	☐	☐
7	I eat at least 2 servings of milk, yogurt or cheese every day.	☐	☐	☐
8	I eat at least 2 servings of meat, poultry, fish, dry beans, eggs or nuts every day.	☐	☐	☐
	TOTAL NUMBER CHECKED	☐	☐	☐

How Did You Do?

Add the number of boxes you checked in each column to rate your diet.

ALWAYS

You have a bumper crop!
If you checked 8 answers in the first column, you are probably getting the nutrients you need. Keep up the good work!
READ ON FOR NEW IDEAS.

SOMETIMES

Your harvest is near!
If you checked the most in the second column, you are on your way to choosing a healthy diet.
READ ON TO LEARN MORE WAYS TO MAKE HEALTHY CHOICES.

NEVER

Sorry, crop hailed out.
If you checked most answers in the third column, you need at least the minimum number of servings from all the food groups.
KEEP READING TO LEARN HOW TO MAKE SMART CHOICES FROM ALL THE FOOD GROUPS.

Part II		THE AMERICAN DIET		Calories
	Breakfast	McDonalds	3 Hotcakes w/butter, syrup	410
			Coffee (2 cups)	0
			Milk (1 cup)	150
	Lunch	Burger King	Whopper	628
			Fries, Regular	227
			Side salad w/ranch dressing	143 (60 + 83)
			Milkshake, vanilla	350
	Dinner	Ponderosa	N.Y. Strip Steak	314
			baked potato	270
			stuffing (4 oz)	230
			bread (1 slice)	65
			macaroni salad (3.5 oz)	335
			fruit yogurt (4 oz)	115
			iced tea	0
	Snack	Dairy Queen	banana split (1/3)	180
		Pizza Hut	Personal Pan Pepperoni (1/2 pie)	680
			cola (12 oz.)	145

THE AMERICAN DIET

SIMPLE + Find the number of calories consumed in:
Breakfast? With a second cup of milk?
The whole day?
If you just ate lunch and a snack?

\- Find the number of calories consumed if:
you ate the salad without dressing?
you had skipped lunch?
you ate 2 hotcakes instead of 3?

MEDIUM DIFFICULTY x Find the number of calories consumed if:
you ate 2 orders of fries?
you ate the whole banana split (Hint - 1/3 = 180 calories)
you went back for seconds on bread?

÷ Find the number of calories consumed if:
you only ate half of your whopper?
you only ate 2 oz. of fruit yogurt?

ADVANCED Proportions Find the number of calories consumed if:
you drank 8 oz of cola ($\frac{12 \text{ oz}}{145 \text{ cal}} = \frac{8}{? \text{ cal}}$) $145 \times 8 = 1160$ $12 / 1160$ 96 c

you ate 6 oz of stuffing ($\frac{1/2}{675} = \frac{3/4}{? \text{ cal}}$) $675 \times 3/4 = 510$
$\frac{510}{1} \div \frac{1}{2} = \frac{510}{1} \times \frac{2}{1} = 1020$

DATA:
DATA ANALYSIS, PROBABILITY AND STATISTICS, AND GRAPHING

Adults make decisions based on data in their daily lives and in the workplace. Reading charts and graphs, interpreting data, and making decisions based on the information are key skills to being a successful worker and an informed citizen. Being an informed citizen includes understanding statistics and probability as well. Adults cannot make reasonable decisions unless they understand from where the statistics come.

Charts and graphs are essential in the workplace. Data from charts and graph are used to make decisions. Graph are useful tools in that they organize data so the information becomes clearer. This organized information can then be used to craw conclusions, to make decisions, or to influence others. Data is organized in a variety of fashions, from charts and graphs, to computer-generated spreadsheets.

Data collection, analysis, and graphing are essential in the workplace. Many industries, manufacturing in particular, now use statistical control processes to monitor their processes in order to ensure quality products. Often the front line employee is required to collect the data used for charting the manufacturing process; therefore, employees at all levels should be knowledgeable about and comfortable with using a variety of charts. As more and more quality teams, consisting of a variety of employees, are charged with the task of ensuring quality products, employees will need to have an understanding of probability and sampling.

There is also the need to have the ability to read and interpret statistical process control charts. Employers want everyone to understand quality. Any chart or graph that shows production uses statistics. Other forms of charting are also used in the workplace to make decisions as well as gauge accuracy.

Statistical knowledge is important in problem solving and decision making. Adults, often without realizing it, make decisions, based on statistical information. It may be via the television, radio, or it may be through print materials. Statistical information is used to communicate information and sometimes influence others. Understanding the flood of statistical information allows adults to make more informed decisions.

Graphs, tables, and statistics make data easier to understand. Adults create graphs for clarity and understanding, for themselves and for others.

Sometimes seeing the data in chart form makes the decision making process easier since the information is clearer. Even when charts and graph are not initiated by adults, they do tend to make the information easier to digest. Charts and graphs are also used for record keeping such as spreadsheets and data bases.

There is a concern for the lack of understanding and ability to read and interpret statistical information, including charts and graphs. There is also worry about use and misuse of statistical information. Transferability is hard for many adults. To know a concept is one thing, but to be able to look at a table and understand and interpret it, is hard to do.

Adults use charts, graphs, and statistical information in their roles as workers, parents, and citizens. As workers, adults use data monitor the quality of the products being made. They also make decisions based on the data. As citizens, adults need to understand the data that they are continually being bombarded with.

IMPLICATIONS FOR LEARNING AND TEACHING

We must introduce more work-related charts and graph and other statistical information to better prepare adults learners for the word of work. Adult learners need much more than simple activities where they are asked to find literal bits of information in more than simple activities where they are asked to find literal bits of information in charts and graph. They need opportunities to collect their own data, then create their own charts and graph. In designing their own charts, adult learners begin to understand how data can be represented. Employees at all levels are begin required to read and interpret charts and graphs, so adult learners need to be prepared.

We must provide hands-on experiences collecting, organizing, and interpreting data. It is not enough that adult education classes give learners practice in simply reading and finding literal information based on charts and graph. Providing adults learners with the actual experience of gathering data, deciding on how to represent the data, and interpreting the results will give them a deeper understanding of statistical information. Adult learners need opportunities to interpret charts and graphs and discuss their finding and implications with others.

TITLE - Percentages, projections, and multi-colored candies

MATERIALS LIST - small bags of multi-colored candies like M & M's for each student, 1 large bag of M & M's for the class,
Tables 1 and 2 - provided
Optional - calculator

TARGET AUDIENCE - ABE/pre-GED/GED

MODE OF INSTRUCTION - Class or large group

ACTIVITY -

1. Give each student a small bag of candies.

2. Open bag and count individual colors in each bag. Figure out the fractions of different colored candies -- the number of candies of each color divided by the total number of candies and then change it to the percent of each color. Plain M & M's come in six different colors. (Use the calculator, if desired, to figure the percent.)

Put your percents into Table 1.

3. Average the percents in each column to find the calculated average percent for each color. (Add all the percent numbers in each column and divide by the total number of percents; this will be the same as the total number of participating students).

Put your averaged percents into Table 1.

4. Open up the large bag of candies and count them without respect to color. Then calculate how many candies you think that there will be of each color, using the average percent you had calculated in step 3 of this activity. Multiply each percent for the different colors times the total number of candies you have just counted in the large bag.

Fill in Table 2 with your proposed number of candies of each color.

5. Separate the candies into groups by color, and count the candies in

each group.

Log in the actual number of each color of candy in Table 2.

6. Calculate the actual percentage of each color candy in the large bag now by figuring out the fractions and then changing it to a percent.

Enter these actual percentages in Table 2.

7. Compare your percentage from steps # 2, # 3, and # 6 with the company's official percentage of each color (put this into Table 2). (There is a toll free number on a bag of M&M's that you may call for information.) As of May, 1996, the percents for plain M&M's are - red-20%, blue-10%, yellow-20%, green-10%, orange-10%, and brown-30%.

8. Discuss the results. Was the larger bag closer in color percentages than each individual small bag was to the company's official numbers? (probably) How did the average of the percents of the smaller bags found in the bottom row in Table 1 compare to the company's percents? Do you think that these averages would come closer to the company's percents with the more students involved in the project? (probably) How did your proposed number of multi-colored candies in the large bag compare with the actual number of candies, by color, counted in the large bag. See Table 2.

9. Eat the candies and enjoy!

WHY I LIKE THIS ACTIVITY - I liked this activity as it is fun, and the student gets experience in actual data collection and in making projections.

SUGGESTIONS FOR EXTENSION - Have the students think of how they could display their data. A bar graph of the data could show the percents of each color with a different bar for the averaged percents of the small bags, the large bag, and the company's percents. The horizontal axis could show the color names and the vertical axis could give the percent.

TIME - Approximately two hours.

TABLE 1 - Percentages, projections, and multi-colored candies						
(Log in data here from steps 2 and 3)						
	Blue	Green	Orange	Red	Yellow	Brown
Student 1						
Student 2						
Student 3						
Student 4						
Student 5						
Student 6						
Student 7						
Student 8						
Student 9						
Student 10						
Student 11						
Student 12						
AVERAGE						

TABLE 2 - Percentages, projections, and multi-colored candies						
(Enter data here from steps 4,5,6 and 7)						
	Blue	Green	Orange	Red	Yellow	Brown
Proposed number of multi-colored candies in the large bag (step 4)						
Actual number (step 5)						
Actual percentage (step 6)						
Company's official percentage (step 7)						

TITLE - World Population and World Land Area Graphing and Analysis

MATERIALS LIST - rulers, Tables 1-4 provided; Bar and Circle graphs (Graphs 1-8) - provided
Optional - world map or globe, protractor, encyclopedia, calculator, styrofoam cup, colored pencils, and compass

TARGET AUDIENCE - Pre-GED/GED

MODE OF INSTRUCTION - Small group or individual

ACTIVITY -

1. Gather data on the world population and world land area for each of the seven continents. Have students use the encyclopedia to get the information and fill in some of Table 3. For an easier activity, use the information already given in Table 1.

2. Make two bar graphs (Graphs 2 and 4) - one for population and one for land area. Use the information provided in Table 1 or what the student put in Table 3. For an easier activity, the completed graphs (Graph 1 and 3) could be used.

3. Teaching suggestions for utilizing bar graphs - Ask the students to rank the continents in order from greatest to least in population and in land area. Ask questions like: What other continent has about the same population as Africa? (answer - Europe). Also how do Africa and Europe compare in land area? (Africa is larger). Based on this information, do you think that Africa or Europe has more people per square mile? (Europe). At this point as we are talking about population density, this could also be looked up in the encyclopedia for all continents or it could be computed by the following formula -- population (in millions) divided by the area (in millions of square miles) equals the number of people per square mile. How does North America compare to Europe in population? (Europe has more people). What is the population density of North America? of South America? of Europe? of Hong Kong? Do many people live in Siberia? How does the population density of cities or of different areas of a continent compare to the population density of the continent as a whole?

4. Make two circle graphs (use Graph 6 and 8 or construct your own) - one for population and one for land area following the directions given below. (For an easier activity, the completed graphs (Graph 5 and 7) could be used.)

Making the circle graphs --

A circle graph shows how the total is divided. To construct a circle graph, therefore, we must first find each continent's percentage of the total world population and world land area. (For an easier activity these percentages may be copied from Table 3.) For a more challenging activity compute these percentages by first adding the population and then the land area numbers on Table 3 to find their respective totals. Next, take each continent and find its percentage of the total. For example, Africa population/total world population = 650 million/5,306.5 million = .122 = 12% (rounded). (If you compute the percentages and compare with Table 1, you will notice some adjustments have been made. The rules for rounding were not strictly followed as I tried to keep the percents mostly in whole numbers while still adding up to 100%.)

The circle graphs should now be divided into wedges representing each continent's percent of the whole. For an easier activity use Graphs 6 and 8 which are circles divided into 10 segments, each segement containing 10 percent (10 x 10 = 100 %). Have the student use different colored pencils to indicate the percent representative of each continent and label them appropriately.

For a more challenging project, use the percent to determine the size of the wedges in degrees using either Method 1 ot Method 2 as follows:

Method 1 - The entire circle contains 360 degrees, so a proportion can be set up to solve for the number of degrees in a wedge. For example, Africa at 12% of the population is represented by a wedge of 43.2 degrees, as determined by the following method:

AS 12/100 = s/360 where s = the size of the wedge (central angle
100s = 4320 for each sector) in degrees
s = 43.2 degrees or 43 degrees (rounded)

Method 2 - As the percent times the whole equals the part, multiply each percent by 360 degrees. For example, Africa at 12% would be solved as follows:

.12 x 360 = 43.2 degrees.

Choose one of these two methods and compute the degrees and fill in Table 4. You may check that your answers are close to those in Table 2.

Instead of using Graphs 6 and 8, have the student draw their own circle (using the top of a styrofoam cup for the outline, or use a compass). Use a protractor to measure the degrees inside your circle. Start by drawing any radius of the circle (Figure 1). This will be the base line for the first angle. Using the protractor, mark off the 43.2 degrees for Africa's 12% of the population (Figure 2). ~~Either~~ use the second radius can now be used for the second wedge, Asia's at 220 degrees for 61% of the population (Figure 3). Continue using this process, using the protractor to complete the population and the land area circle graphs.

Figure 1

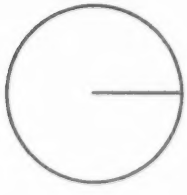


Figure 2

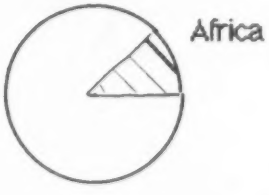
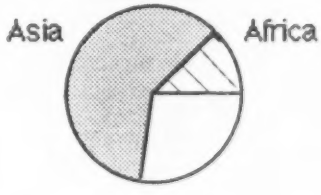


Figure 3



In making the graphs, the student could use different colored pencils to color the wedges for each continent and label them appropriately.

5. Teaching suggestions for circle graphs - Discuss the graphs and compare the percentages of the different continents. Draw some conclusions by asking: What continent is about the same size as Europe and Antarctica together? (North America). What continent is around three times the size of Europe? (Africa). Discuss the mathematical activities used -- changing fractions to decimals and then to equivalent percents; percents written as fractions and then changed to degrees by using

proportions; and/or percents multiplied times the whole to get the part.

WHY I LIKED THIS ACTIVITY - I liked this activity as it connects math and geography. It can be adjusted to be used at an easier or more difficult level as indicated within the activity description.

SUGGESTIONS FOR EXTENSION - Additional research on continents using the encyclopedia, newspaper articles, etc. could be done in class. Also math work involving conversions between time zones and map reading including longitude and latitude locations could be included.

TIME - One hour or several class sessions.

TABLE 1

	Population (in millions)	Area (in millions of square miles)	Population %	Area %
Africa	650	12	12%	21%
Antarctica	0	5	0%	9%
Asia	3200	17	61%	30%
Australia	16.5	3	0.3%	5%
Europe	700	4	13%	7%
North America	440	9	8%	16%
South America	300	7	5.7%	12%
TOTAL	5306.5	57	100%	100%

TABLE 2

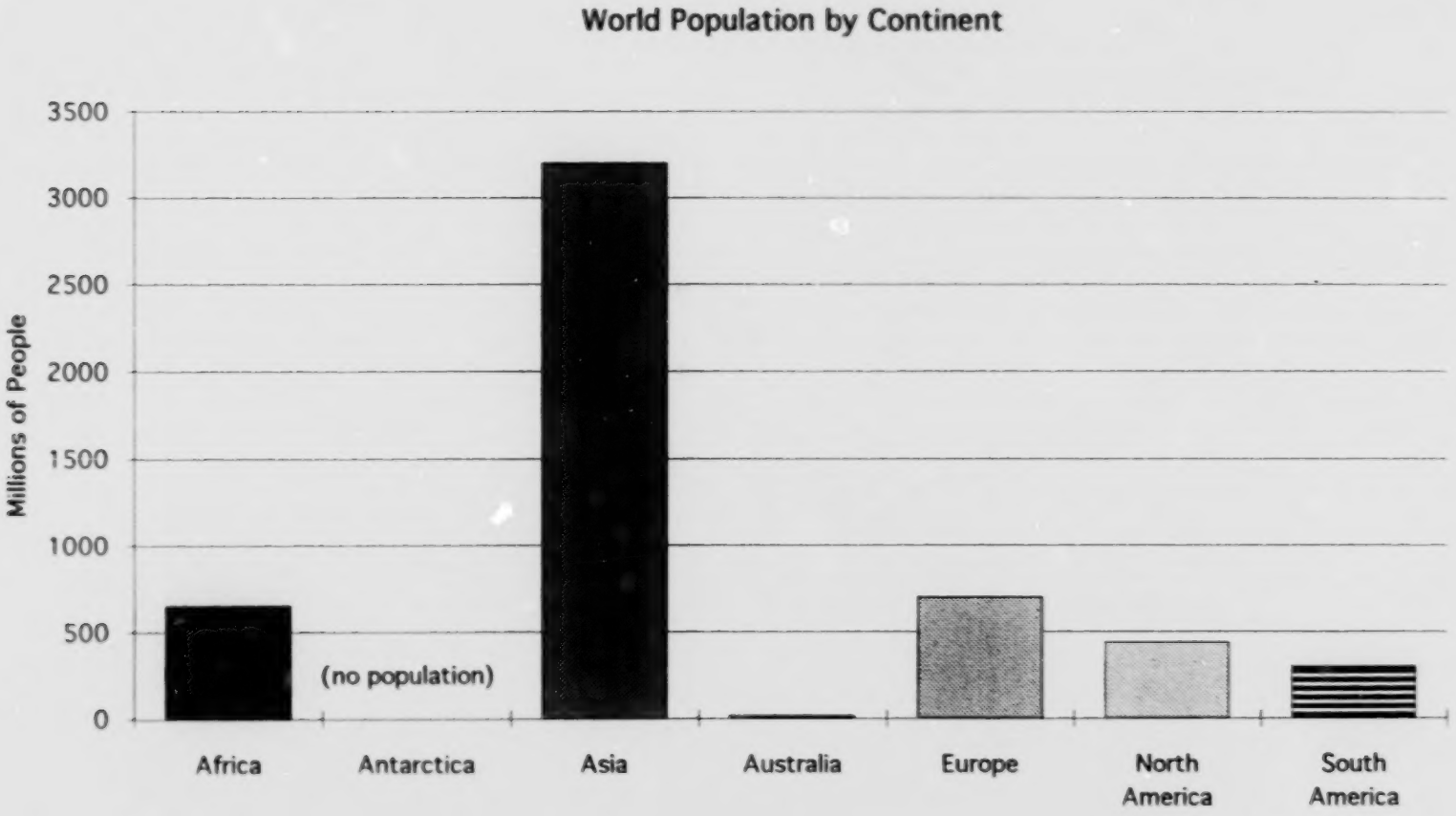
	Population (degrees of circle graph)	Area (degrees of circle graph)		
Africa	43	76		
Antarctica	0	32		
Asia	220	108		
Australia	1	18		
Europe	47	25		
North America	29	58		
South America	20	43		
TOTAL	360	360		

TABLE 3

	Population (in millions)	Area (in millions of square miles)	Population %	Area %
Africa				
Antarctica				
Asia				
Australia				
Europe				
North America				
South America				
TOTAL				

TABLE 4

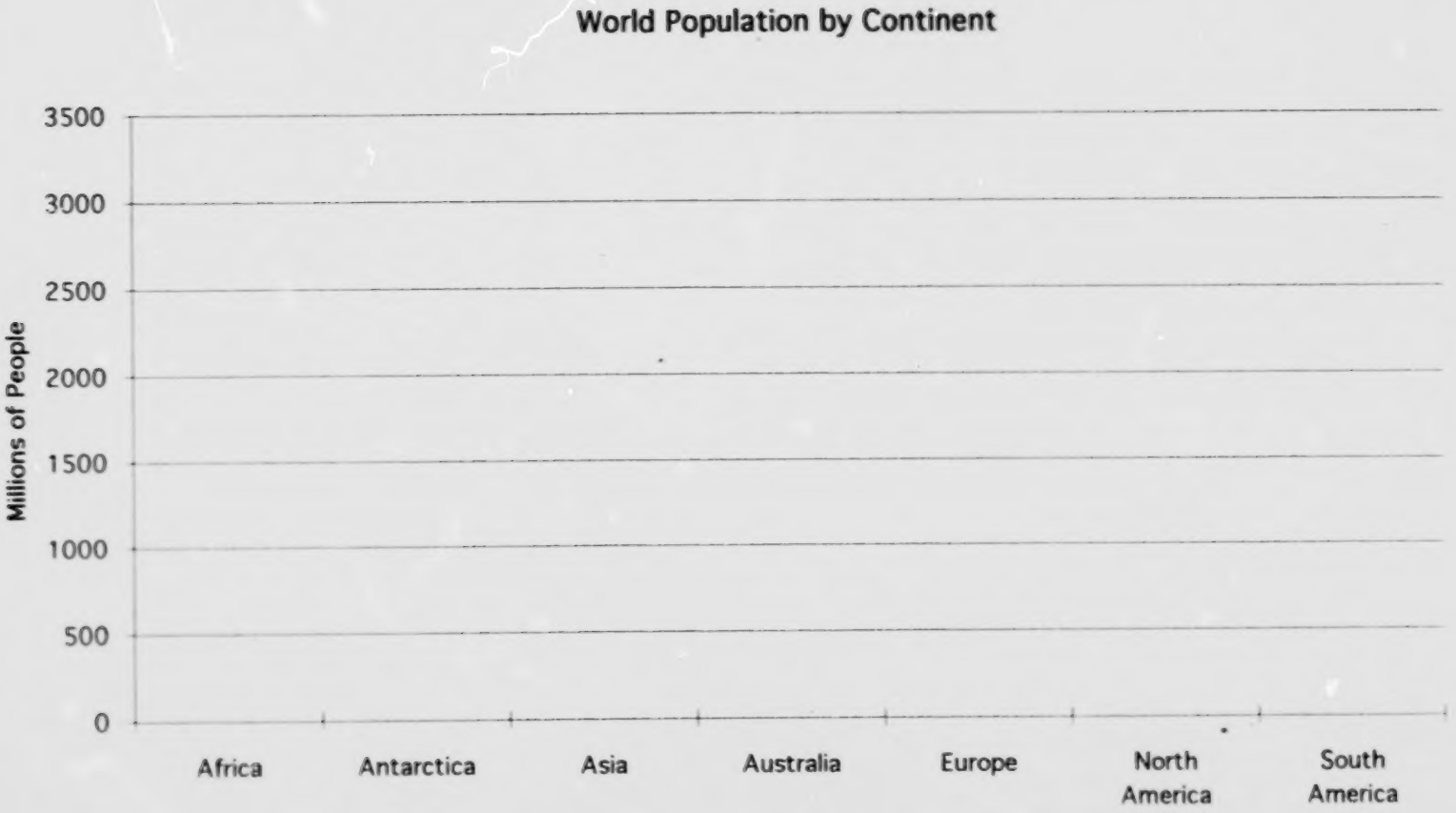
	Population (degrees of circle graph)	Area (degrees of circle graph)		
Africa				
Antarctica				
Asia				
Australia				
Europe				
North America				
South America				
TOTAL				


World Population by Continent
Millions of People
3500
3000
2500
2000
1500
1000
500
0
(no population)
Africa
Antarctica
Asia
Australia
Europe
North America
South America

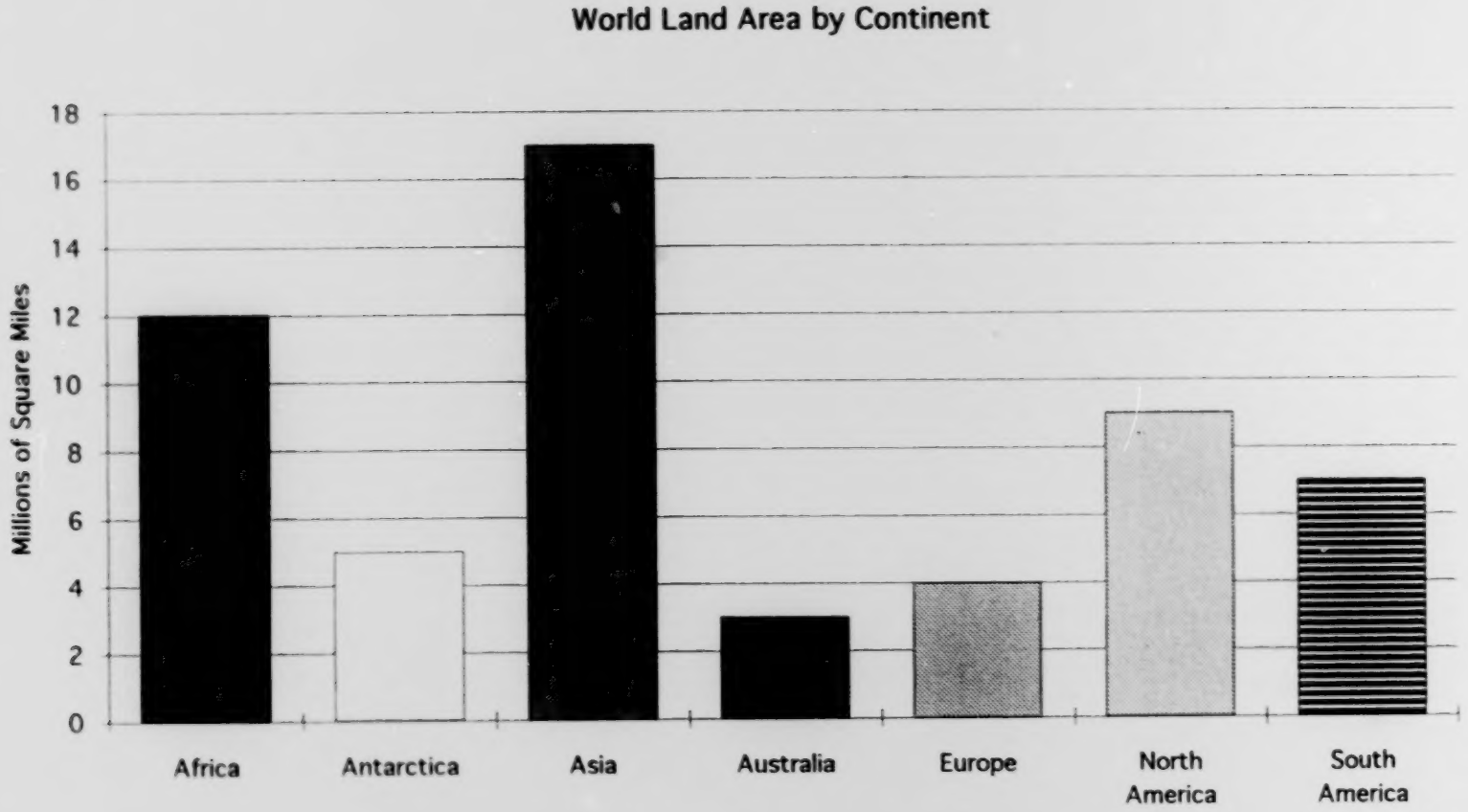
97

98

Graph 1


World Population by Continent
Millions of People
3500
3000
2500
2000
1500
1000
500
0
Africa
Antarctica
Asia
Australia
Europe
North America
South America

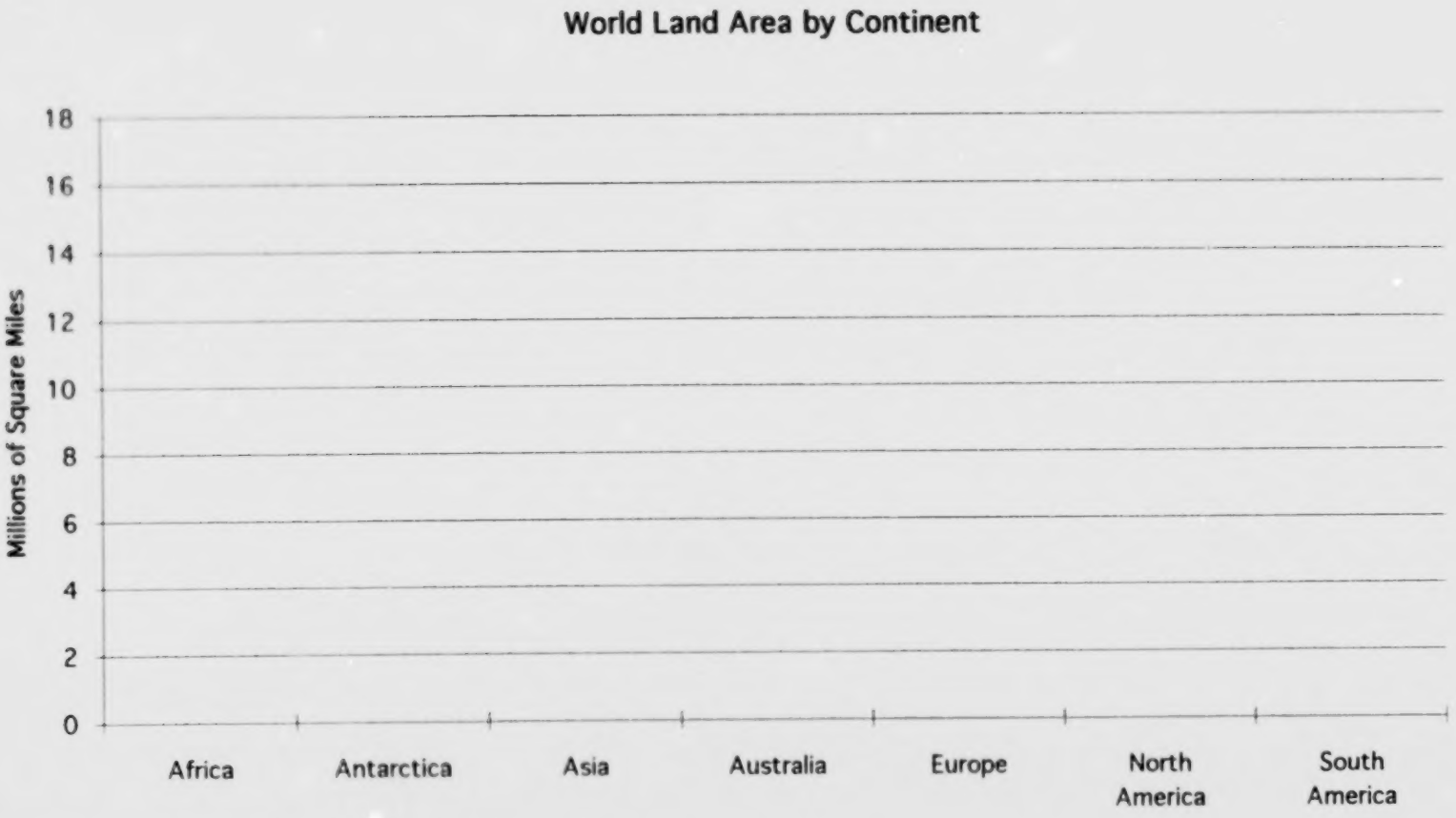
Graph 2



101

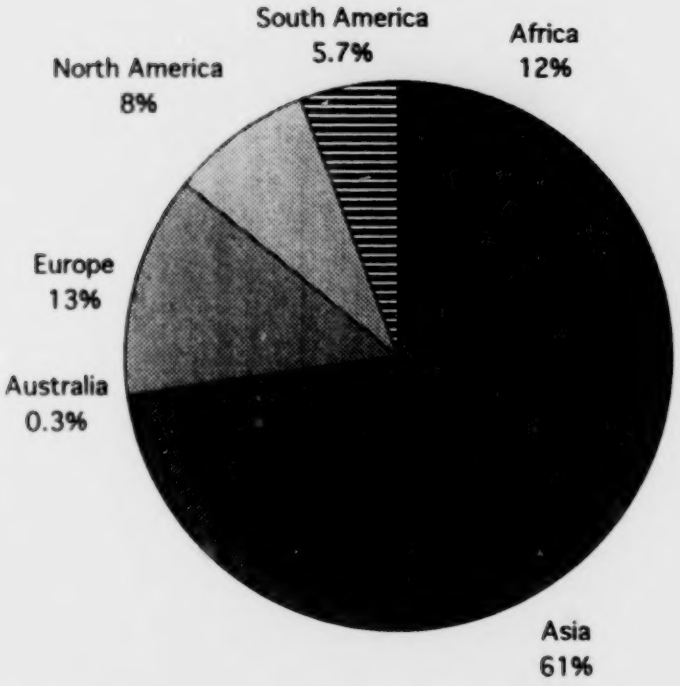
Graph 3

102


World Land Area by Continent
Millions of Square Miles
18
16
14
12
10
8
6
4
2
0
Africa
Antarctica
Asia
Australia
Europe
North America
South America

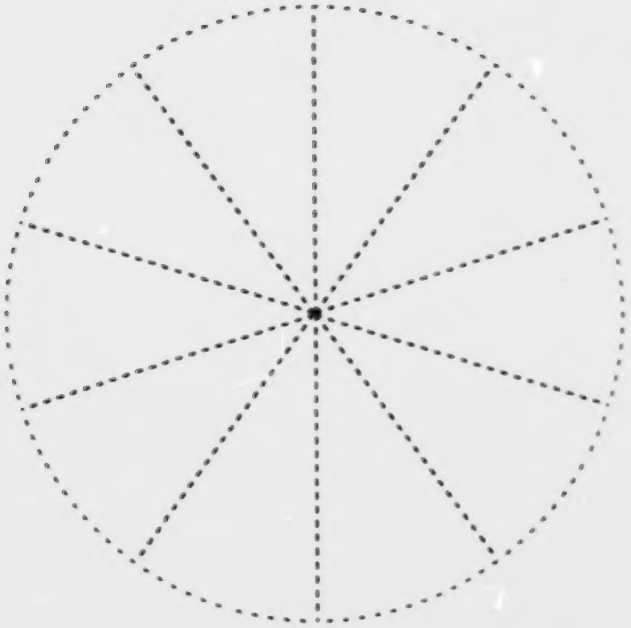
Graph 4

World Population

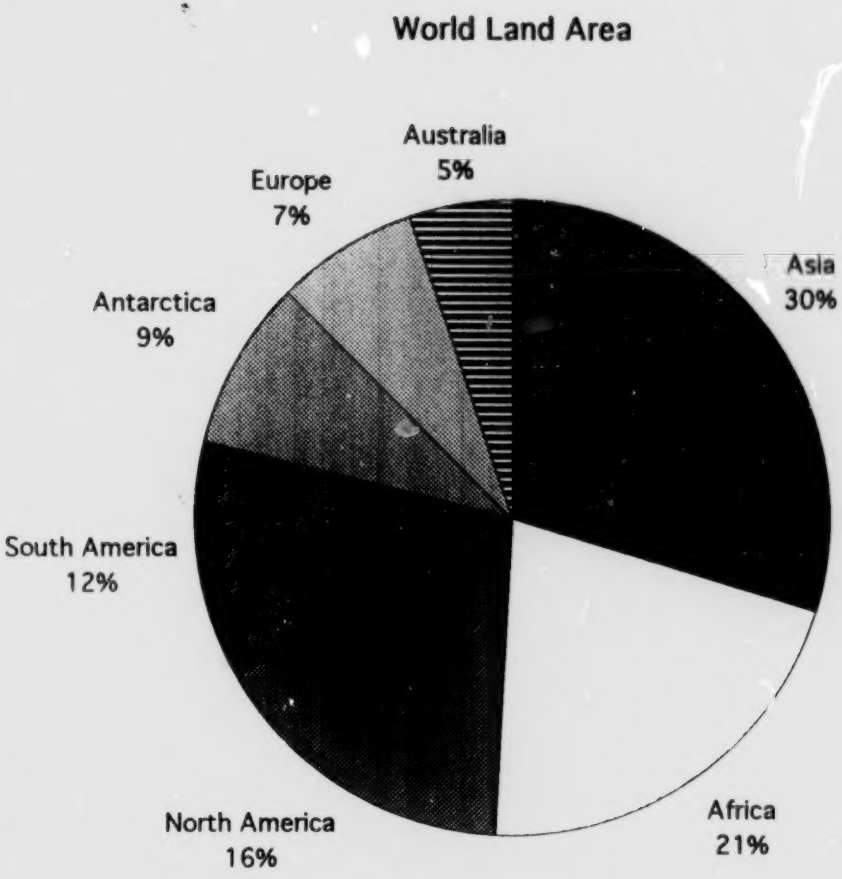


Graph 5

World Population

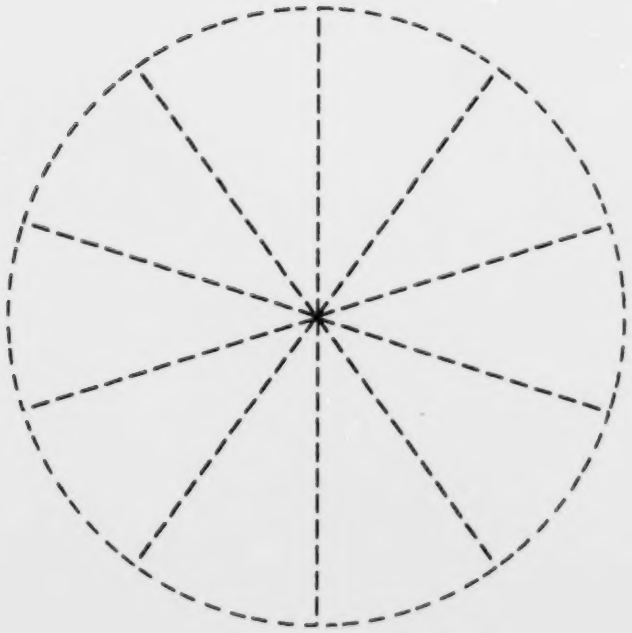


Graph 6


World Land Area
Australia
5%
Europe
7%
Asia
30%
Antarctica
9%
South America
12%
North America
16%
Africa
21%

Graph 7

World Land Area



Graph 8

Title: **STATISTICS, PROBABILITY AND CONNECTIONS USING THE MORTALITY TABLE**

Materials: Mortality tables from different periods
Computer software for creating tables or spreadsheets
Calculators
Graph paper
Color markers or pencils

Target Audience: ABLE/JOBS Adult Students

Mode of Instruction: Small group or Whole class

Rationale: Adult education should put less emphasis on teaching isolated mathematical skills and increase emphasis on teaching the math of life skills and the world of work. Investigation of statistics and probability should actively engage learners in exploring events and making predictions about situations relevant to their daily lives. Adults know that decisions made on the basis of various statistics affect them daily. Collection, organization, calculation, and interpretation of data are fundamental to our personal lives and the lives of most adults in the workplace. Adults use and analyze statistics and, formally or informally, predict outcomes daily.

Therefore, it is important that adult learners understand how statistical representations and calculations are used. There is nothing more indigenous or relevant to human life than mortality. Using mortality tables from different time periods is an effective way to investigate changes and predict future change. It also is a means of getting adults who smoke (many of our students do) or have other dangerous lifestyles to consider their own mortality and that of their children.

Statistics, Probability, Data Collection, and Insurance

One of the largest businesses in the United States which relies heavily on statistics and probability is insurance. It is very important to an insurance company to know how to **measure the risks** against which people are buying the insurance. In order to **set the premiums**, a fire insurance company must have some way of knowing how many fires will occur. An automobile insurance company must be able to **predict the number** of accidents involving injury, loss of life, and property damage. A life insurance company must know what the expected number of deaths will be in a given group of policyholders.

(ACTIVITY 1) Class or Small Group Discussion - List of Ideas or Plans- Discussion of Feasibility of Ideas, Collection of Data

How then will companies such as these **make their estimates**?
How will they, how would you **estimate the probability**:
-that an 18-year old male driver will be involved in an automobile accident this year?
-that a new all-brick house in your community will burn?
-that a 70-year old man will be hospitalized this year?
-that a 16-year old person will die before reaching age 17?

Summary Implications:

You know immediately that in order to arrive at estimates such as these, some **data must be collected**. The **automobile insurance** company will have to gather data on the 18-year old male drivers in order to tell what the experience is likely to be - **how many accidents** this group of drivers has, on the average. Or the **fire insurance** company must compile statistics on **fires** among all-brick houses **in communities** having adequate fire departments. And **life insurance** companies must have available some statistics that will show **how many** 16-year olds **die**, on the average.

Data such as these must be **based on large numbers of events**. Operating in cases such as these is the Law of Large Numbers, which, stated simply, means that with large groups we can predict fairly accurately what is likely to happen. With a large number of experiments, the ratio of the number of successes to the number of trials does approach the theoretical probability.

Life insurance companies use sets of statistics called mortality tables to predict how many people of the same age will die in a particular year. The companies assume that what will happen in the future will be similar to what happened in the recent past. A mortality table is **based on the lives and deaths of policyholders of several large life insurance companies**. It has a margin of safety added, and although it might not be used for premium calculations, it is **used for making other calculations** necessary to life insurance company operations. It is a **table of probabilities**, also.

(ACTIVITY 2) Creating Tables and Graphs - Organizing Data
If available, have students use computer programs to create tables and graphs of the selected information below. If computers are not available, have students draw a table of the information below and create a graph, using graph or lined paper and color pencils or markers, based on the table.

A 1958 United States Commissioners Standard Ordinary Table of Mortality **(Table 1)** listed the following selected **probabilities**:

-At age 0, the probability that death would occur within 1 year was 7.08/1000
-At age 1, the probability that death would occur within 1 year was 1.76/1000
-At age 15, the probability that death would occur within 1 year was 1.46/1000
-At age 30, the probability that death would occur within 1 year was 2.13/1000
-At age 45, the probability that death would occur within 1 year was 5.35/1000
-At age 60 the probability that death would occur within 1 year was 20.34/1000
-At age 75 the probability that death would occur within1 year was73.37/1000
-At age 90 the probability that death would occur within 1 yr. was 228.14/1000
-At age 99 the probability that death would occur within 1 yr. was 1000/1000

It is customary in the table to speak of the **annual rate of death per 1000** persons rather than to call this the probability of death at a given age.

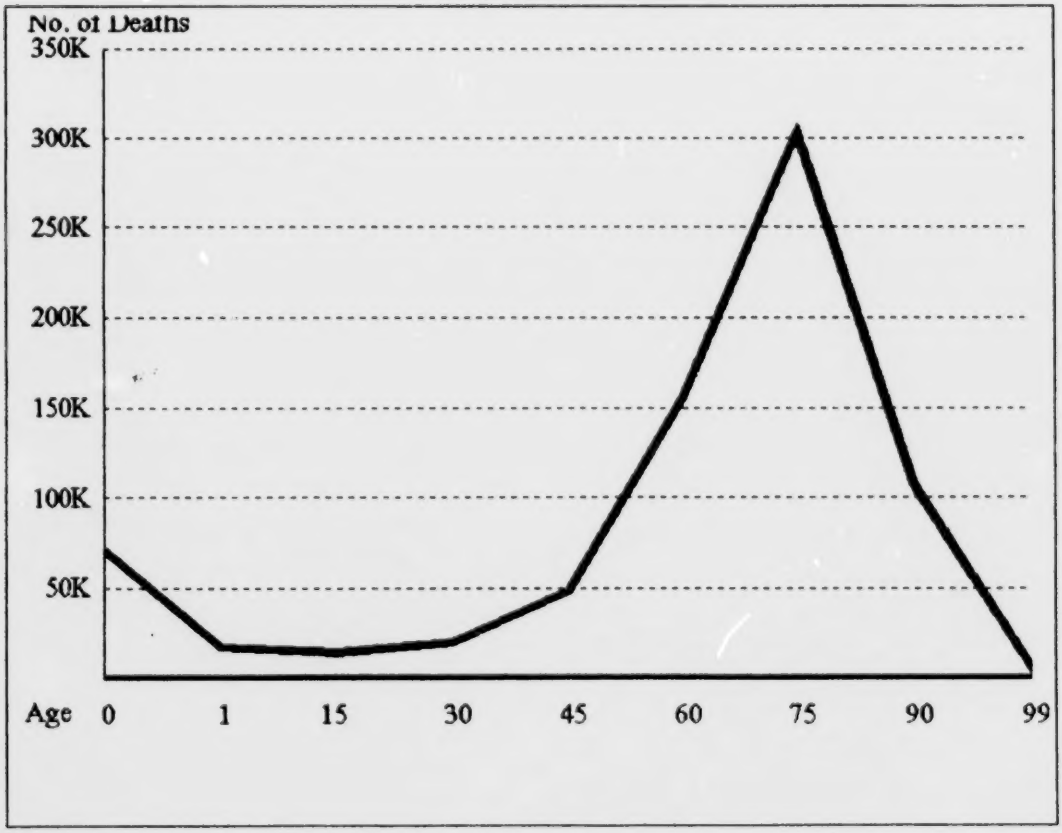
(ACTIVITY 3) Interpreting Data - Questions for class or small group discussion, group reports, or writing assignment.
-Why was the probability of death at birth so much greater than at age one?
-Why would the probability almost quadruple between ages 45 and 60?
-Why would the probability almost quadruple between ages 75 and 90?
-What could be done to change these statistics?

(Table 1)

1958 Commissioners Standard Ordinary Table of Mortality

Age	Number Living	Deaths Each Year	Deaths Per 1000
0	10,000,000	70,800	7.08
1	9,929,200	17,475	1.76
15	9,743,175	14,225	1.46
30	9,480,358	20,193	2.13
45	9,048,999	48,412	5.35
60	7,698,698	156,592	20.34
75	4,129,906	303,011	73.37
90	468,174	106,809	228.14
99	6,415	6,415	1,000

Graph for Table 1



On the basis of these statistics, a life insurance company can make predictions as to how many policyholders will be expected to die each year, and will thus **know how much money will have to be paid out in claims**. Although the life insurance company never knows who will die, it can tell from the table approximately how many people in a group - all the same age - will die at any given age. **Life insurance companies compile their own mortality tables, based on their own experience** with their policyholders, and these tables are revised regularly. It is from these tables that companies secure the **basic data needed for establishing the cost** of life insurance.

To make up a mortality table, the **life insurance actuary must determine the death rate of each age**. **If**, for example, the number of **policyholders age 16 at the start of the year was 5,844**, and the **number who died during the year was 9, the probability of dying was 9/5844**. **But in life insurance, instead of stating probability as a fraction, it is stated as the death rate per 1,000.**

(ACTIVITY 4) Using Proportion, Compute the Death Rate for Age Groups With a Calculator or Paper and Pencil. To figure the annual death rate per 1,000, the actuary uses this proportion:

$$\frac{X}{1{,}000} = \frac{\text{No. dying during year}}{\text{No. living at start of year}}$$

X = Death rate per 1,000 for 16-year-olds

With this formula, we can determine X for the 16-year-old group:

$$\frac{X}{1{,}000} = \frac{9}{5{,}844}$$

$$(5{,}844)(X) = (9)(1{,}000)$$

$$X = \frac{9{,}000}{5{,}844}$$

X = 1.54, death rate per 1,000 for 17-year-olds

With this calculation, we learn that out of every set of 1,000 16-year-old policyholders of that company, **it is expected that on the average 1.54 will die before reaching age 17. At age 17, there were 5,835 persons living at the start of the year, and the company had added 263 new 17-year old policyholders, making a total of 6,098. During the year 10 died. Using the same proportion:**

$$\frac{X}{1{,}000} = \frac{10}{6{,}098}$$

$$6{,}098\,X = 10{,}000$$

$$X = \frac{10{,}000}{6{,}098}$$

X = 1.64, the death rate per 1,000 at age 17

(ACTIVITY 5) Complete The Table:

Age	No. of Policyholders at start of year	No. dying	Death rate per 1,000
16	5,844	9	1.54
17	6,098	10	1.64
18	6,433	11	-----
19	7,955	14	-----
20	9,551	17	-----

Once the death rate per 1,000 for each age is known, it is not difficult to construct a mortality table for any group. **Now, you can proceed to construct a mortality table for that company starting with 50,000 young people, age 16:**

(ACTIVITY 6) Complete the Table With 50,000 Young People, Age 16:

Age	No. of Policyholders at start of year	Death Rate per 1,000	No. dying during year
16	50,000	1.54	77
17	49,923	1.64	82
18	49,841	1.71	----
19	------	1.76	----
20	------	1.78	-----

How do we conclude that 77 people die during the year? By taking the death rate per 1,000, as calculated, we can work it out as follows:
--1.54 (death rate per 1,000 at age 16) x 50 = 77
The original group of 50,000 is now reduced by 77, leaving 45,923, at age 17.

(ACTIVITY 7) Analyzing Data (Statistics) - Predicting (Probability)
Compare data from Table 1(1958) and Tables 2 & 3 (1980)

-Compare statistics of individual age groups from 1958 and 1980.
-How do statistics differ?
-Why do statistics differ?
-Which statistics show the greatest increase or decrease?
-Will the probabilities of death change significantly for any age group in the 1990 Mortality Tables?
-Compare statistics of Table 2 (Male) & Table 3 (Female).
-How do statistics differ?
-Why do statistics differ?
-Which age groups differ significantly for life expectency and rates?
-Which age group will show the greatest change in the 1990 table?
-Why?
-What can be done to increase life expectency?

(Table 2)
1980 CSO Mortality Table
(Male–Age Last Birthday)

Age	Life Expectancy (Years)	Deaths Per 1,000
0	70.8	4.18
1	70.1	1.07
15	56.9	1.33
30	43.2	1.73
45	29.6	4.55
60	17.5	16.08
75	8.3	64.19
90	3.2	221.77
99	0.5	1,000.00

(Table 3)
1980 CSO Mortality Table
(Female–Age Last Birthday)

Age	Life Expectancy (Years)	Deaths Per 1,000
0	75.8	2.89
1	75	0.87
15	61.8	0.85
30	47.6	1.35
45	33.9	3.56
60	21.2	9.47
75	10.3	38.24
90	3.5	190.75
99	0.5	1,000

EVALUATION:

Evaluation of the group process could be accomplished with a rubric or continuum which can be easily marked as the instructor observes class or small group activities. **Individual evaluation** could also employ the continuum and assess the proficiency with which the adult learner creates, organizes, and analyzes the data. If technology is not available, the accuracy of the drawn graph, based on information in the table, can be assessed. Also, how well do the learners connect the fraction, proportion, decimal, and multiplication operations in the activities and relate them to their life? How does the learner score on a test of the mathematical operations utilized by an actuary?

RECOMMENDED RESOURCES:

Insurance Agents (ask for recent mortality tables)
The GED Math Problem-Solver (author, Manly)
Number Power 8: Analyzing Data (author,Frechette)
Real Numbers: Tables, Graphs, and Data Interpretation (author, Suter)
Family Math (authors, Stenmark, Thompson, and Cossey)

MODIFICATIONS:

Mortality Tables from a variety of time periods could be gathered by the class for investigation of the history of the time that influenced the mortality rate. A class discussion or project would be useful in summarizing factors that contribute to death at different ages and preventive measures that can be taken Data from other topics could be gathered, organized, and analyzed using computer technology if possible. .

KICK OFF ACTIVITY

SHARE WITH YOUR CLASS THE STATISTICS COLLECTED BY MIAMI UNIVERSITY STUDENT AND G.E.D. RECIPIENT SUSAN MELLOTT. Most students will be able to identify with some of these statistics and be very interested in them. After some discussion, suggest a "Statistics Month." Invite speakers who use statistics in their business to speak to the class. This list may include school and city government officials, insurance agents, health professional, and others. Discuss how statistics can be gathered and used to make generalizations about peolpe, places and things and that these are not always fair to the individual. Lead into the following project from which the class will then make "generalizations" about neighborhoods, including their own!

HIGH CRIME REGIONS IN CITIES

Newspapers are wonderful in the classroom. Begin collecting local crime reports from daily newspapers. Discuss what areas of the city that they expect to find a high incidence of crime. Discuss how crime is related to such things as population density, price of average house, distance from neighbors, etc. Make predictions and see what happens!

You will need a large detailed map of your city. Practice finding streets on the map. Discuss the kinds of crime students expect to read about and color-code the crime to a color of map pin. Have groups take turns collecting articles and placing pins on the map.

Data should be collected for at least a month to allow for patterns to form. Make smaller outline maps and have students use different techniques to illustrate the pattern of crime. Discuss who is interested in such statistics. Invite a police officer to close this activity by bringing in statistics for a longer period of time to see how their short sampling compares.

CONNECTIONS: Daily **reading** is encouraged through this activity. Drawing conclusions and illustrating the data will make students more comfortable attempting to make sense out of **social studies** and **science** data.

Writing can follow in a number of ways. The data could be used to write a comparison of two areas of the city. An opinion essay could be written on whether pizza delivery services should be allowed to exclude certain neighborhoods from their route.

STATISTICS

Provided by: Susan A. Mellott
A student at Miami University

CONNECTIONS BETWEEN EDUCATION AND POVERTY FOR WOMEN

- **75%** of female heads of household with less than a high school diploma are living below the national poverty line.

- **40%** of female single parents have an eighth grade level education or less.

- **35%** of displaced homemakers have less than an eighth grade education.

- In **1990**, over **67.3%** of women who worked without a high school diploma earned less than $12,400.00 per year.

- **One** in **Eight** women workers has less than a high school diploma.

- People with less than a high school education will only be able to fill **14%** of the jobs that will be available in the future.

INCOME AND WAGE GAPS CONCERNING WOMEN

- In **1939**- women made sixty-three cents for every dollar a man earned.

- In **1985**- women narrowed this gap by increasing their wages to sixty-four cents for every dollar a man earned.

- Our country offers women less income than other industrialized nations:
  - **In 1980:**
    Sweden- women earned eighty one cents for every dollar earned by a man.
    Britain- women earned sixty-six cents for every dollar earned by a man.

- In **1984**- the average yearly income for a woman was $14,479.00, as compared to $23,218 which is the average yearly income for an average man.

GIVE EXAMPLES OF SOME PROBABILITY QUESTIONS.

Games are usually interesting. For example, if a friend challenges you to draw an ace on your first pick for a free lunch, how good are your chances of winning? Since there are 4 aces in 52 cards, your chances of winning are 4/52 or 1/13. So the probability of not picking an ace is 48/52 or 12/13! The odds are against you, but not too impossible.

Now let's say the friend has challenged you to roll dice - two of them. He will buy you lunch if you roll a six on each dice. So what is the probability of getting a free lunch? Your chances of rolling a six on one dice is 1/6. But how about both at the same time? Now we have to multiply the probability of getting a six on each die. Now your chances are 1/6 x 1/6 or 1/36. Your chances of rolling 2 sixes are much worse that drawing an ace out of a deck of cards.

Another example would be a "Pick Three" in the Lottery. If your chances are 1/10 for each number, then your chances of picking all three correct would be 1/10 x 1/10 x 1/10 or 1/1000! Save your money!

•SMARTIES CEREAL • WIN YOUR GED! •
•A WINNER IN EVERY BOX!•

In Figmentland, USA, marketing specialists decided that they would promote *Smarties* Cereal by giving away coupons in specially marked boxes. These coupons could be redeemed for passing scores on the GED Test. Writing Skills, Essay, Social Studies, Science, Literature, and Mathematics coupons were put in Smarties Cereal. Equal numbers of each coupon were placed in boxes and distributed evenly to area stores.

Since your chances of getting any of the coupons are the same, how many boxes of *Smarties* Cereal would you expect to have to buy in order to collect all six coupons?

Is it possible to get all six coupons in only six boxes?
Is it possible that you might buy 100 boxes and still not get all six?

Let's set up a simulation or "act out" the problem.

SPINNERS WITH 6 EQUAL AREAS
CUBES
HANDMADE COUPONS ON 3 X 5 CARDS
OVERHEAD DICE (TRANSPARENT) if doing project with whole class together.

•Each group should run three trials with their materials and keep track of the number of times it took to get all 6 coupons.
•Using transparent grid paper, plot the data.
•Calculate Mean, Mode, and Range.
•How could the manufacturers of *Smarties* Cereal make the odds of winning lower?

Tallying the results of the simulation can be done in several different ways. I have used "100" GRID" PAPER. Using that, they star a number when it is a coupon that they have not yet gotten. Then on spins that are duplicates, either just mark out the number or record the duplicate subject name. By recording the name of each spin, at the end other numbers can be tabulated such as how many times was each subject area spun. Also the last number starred will be the total number of attempts that it took to get coupons for all sections of the GED Test.

A CERTAINTY

A.B.L.E. STUDENTS EXAMINE TAXES

Rationale and Overview:

"In this world nothing is certain but death and taxes."
-- Benjamin Franklin

Adult students deal with tax costs and benefits regularly. Gaining greater understanding of the tax system, where tax money comes from and how it's used, can help them understand and appreciate the application of classroom mathematics to real life situations.

A study of taxes can help students integrate understandings from the areas of social studies and mathematics. Students are interested in how their own money is spent. This unit could logically follow a study of family budgets, emphasizing the need for the government unit to also budget its income and expenses. As students develop an interest in how tax money is spent, they may also develop an interest in participating in the system to help influence how the government allocates financial priorities.

When my 14-year-old daughter collected her first paycheck, she quickly noticed that several deductions had lessened the amount she'd expected. She wanted to know why that money was taken away from her, who said they could do that, who decided how much money to take, what did those people do with her money, and what did she get out of the deal. After a lot of discussion, her final comment was, "No wonder you guys vote." We and our students have wondered the same things, and this unit gives everyone an opportunity to develop and express opinions, quantify them, and compare their ideas to reality.

Discussing what students already know about taxes, using math skills to analyze their opinions, and comparing their concepts to real life examples gives them many opportunities to build new understandings and grow.

APPLICATIONS

Connections to past learning:

Give students some time to consider what they already know about taxes. Encourage them to share their experiences with taxes -- both as payers and consumers. This is a good opportunity to correlate previous learning about taxation and government and information about the history of the United States that relates to this issue. Students use critical thinking, communication skills and reasoning during the discussion. If the need arises, they may want to use information gathering and research skills.

As the unit develops, students practice previously learned math skills in estimating, calculation of whole numbers and percents, averaging, and chart and graph development.

Connections to the real world:

Taxes are a certainty. Income taxes have been collected in the U.S. since 1913, and the Social Security Act of 1935 created the Internal Revenue Service which supervises the collection of federal income taxes. Looking at a sample paycheck will show many deductions for various taxes. Students will be able to name other kinds of taxes from their experience.

Even if a student doesn't currently pay income taxes, other taxes are a reality. Each student can consider how government activities are funded. Then each can consider himself as a consumer of tax money in benefits. The A.B.L.E. classroom itself may enter the discussion.

Students can be encouraged to analyze their own paychecks or tax forms. And they can look for ways their lives benefit from government spending.

Each student has the opportunity to think about how tax money should be allocated, then to compare those opinions to the others in the group and to the real applications of government. Students can be encouraged to understand how taxes (collection and expenditure) may influence individual lives.

Connections to adult life skills:

Adult students participating in this unit will practice language skills. During discussions they'll offer opinions and adjust those opinions based on other input. They'll also use critical thinking and analysis skills as they compare their ideas to actual tax sources and expenditures. Learning about the tax system will help them develop their ability to read, evaluate and understand information from periodicals and broadcasts. Perhaps they will want to express the opinions they develop to their government representatives.

During the unit each student will have many opportunities to apply math skills in reading and writing numbers, comparing and estimating amounts, calculating totals and averages, converting whole numbers to fractions and percents and reading various charts and graphs. Some students may want to learn how to fill out their own IRS forms.

Connections to work:

Using a paycheck to compute the amount or percent of tax contribution can emphasize the importance of learning about taxes. Some students may want information on adjusting their deductions.

As students become aware of how tax money is spent, they may become more interested in how government spending of tax money both creates and influences their own jobs and the jobs of others. Some students may want to learn more about the jobs of the people who collect, disburse and allocate their tax money.

Follow-up:

Create graphs from the class or student charts (on computer?).

Fill out sample tax forms.

Compare graphs showing spending of tax money in previous years to current graphs. Compute the changes and/or discuss what has influenced the differences.

Consider how to reduce the deficit and pay off the federal debt by reducing taxes or reducting spending in certain categories.

Find tax-related articles in periodicals and compare them to the worksheet information.

Contact the budget office for the government unit and ask for budget projections for the coming year.

A.B.L.E. STUDENTS EXAMINE TAXES

LESSON ONE

Objectives:

To help students clarify what they already know about taxes, share and acquire new information and think about how they would like tax money to be distributed by the government.

Activity:

Start a discussion of taxes. Everyone is affected by them, and most people have opinions, generally negative. Suggest the students take their own notes, but keep track of important points on a chalkboard or paper pad.

> *Definition*: Taxes are monies collected to help pay for government services.
>
> *Possible questions to consider:*
> How do individuals and societies satisfy their wants?
> Why do governments assess taxes?
> What are the different kinds of taxes?
> Where does the money come from to run our government?
> How is tax money spent?
> Who decides how the tax money is spent?
> How do they decide how much to spend and on what?
> What do I get for my tax contribution?

Give each student a few minutes to make a list of the areas they think the federal government (or the state, local, school district) should support with tax money. Compare and discuss the lists and develop a class list. Then hand out a list of the actual areas covered by the government unit you're considering. Discuss the types of spending that might fall into each category. Help students fit the items they listed into the categories named in the handout.

Worksheet:

On the handout of categories for tax spending, ask students to consider how they'd like to spend $100 of their own tax money. To encourage thinking and discussion, this could be a small group or home assignment. Ask them to list (in pencil to accomodate changes) their amounts in the first column after the category name. In the second column they could estimate how the government actually spends tax money, or that column could be left blank for the next session.

A.B.L.E. STUDENTS EXAMINE TAXES

LESSON TWO

Objectives:

Students will use the worksheets they prepared individually or in small groups as they analyze their spending priorities. They'll continue to consider the way tax monies are spent while using math skills to compare and discuss quantities. Depending on interest and time, this particular lesson can expand to several sessions, creating additional practical math problem examples or using a computer to generate comparisons.

Activity:

Students can go through the items listed and identify the amount they chose to spend out of their $100 for each category. This part of the lesson could be made more graphic by using $100 in play money and physically placing bills at different stations around the table. Coins could stand for decimal or fractional amounts. Students can be encouraged to explain or defend their choices and even to change them if someone else's comments influence them. When everyone seems reasonably content with his own choices, students can check to be sure the amounts actually add up to $100.

Depending on the level(s) of math experience, students can convert their individual amounts to fractions or percentages of the total $100. Then they should combine the totals into a wall chart, averaging their individual amounts to reach the group concensus amount for each category. If the total doesn't add up to $100, have them discuss why this could happen. Adjust as needed. If a computer is available, the data input could create a pie chart or graph of the individual or group "budget" which would make a graphic comparison to the charts and graphs in published government information, considered in the next lesson. Students should write the group figures (money amounts or decimal / fractional / percentage equivalents) in the second column on their worksheets.

Lots of "word problems" can be developed from these comparisons. Differences can be compared mathematically in several ways. Students can make up their own problems comparing their choices in each category or comparing their choices to the group concensus. Use some imagination. Problems can be worked out in the large group, small groups or individually.

A.B.L.E. STUDENTS EXAMINE TAXES

LESSON THREE

Objectives:

Students will compare their own choices to actual government spending figures. Mathematical comparisons will be figured. Individuals will consider the differences between their own priorities and actual government spending. Some may wish to communicate any concerns to their representatives.

Activity:

The teacher hands out material showing the actual government tax figures. Usually lists, charts and graphs are available from the government unit explaining both receipts and expenditures. How much examination and discussion of these publications is done will depend on the time you have available, but students are usually anxious to compare their choices to the published information. The government figures should be written in the last column on the student worksheet.

Questions and discussion about differences will help to develop previous concepts and encourage critical thinking skills. Students may need encouragement to see why differences exist, not just to negatively criticize government spending that differs from their choices.

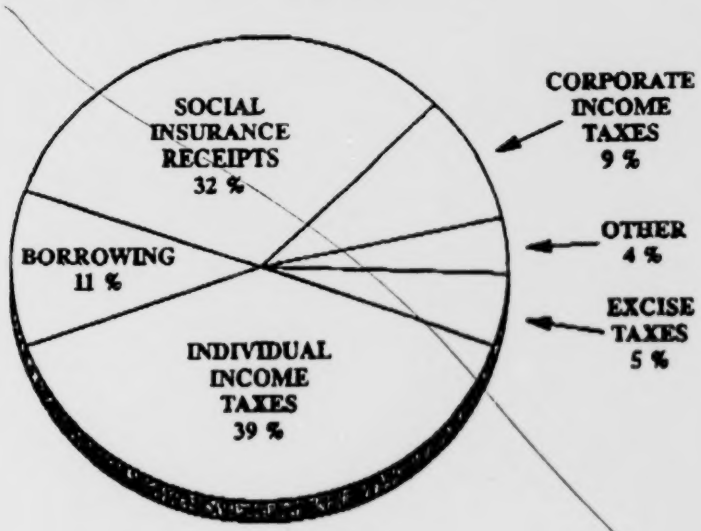
Math skills may be used to find similarities and differences numerically or on graphs. Ratios or algebra could be used to compare the students' $100 amounts to the actual amount spent by the government. Conversion to actual dollar amounts of each student's $100 might be impressive. Students who pay income taxes might be interested in finding out how much of their tax money supports each category. Again, use your imagination; let the students make up their own comparisons.

If there's enough interest, repeat the activities for other government units (state, city, school district). Or start with those units in the first place, if students are better able to relate to local revenue and expenditures.

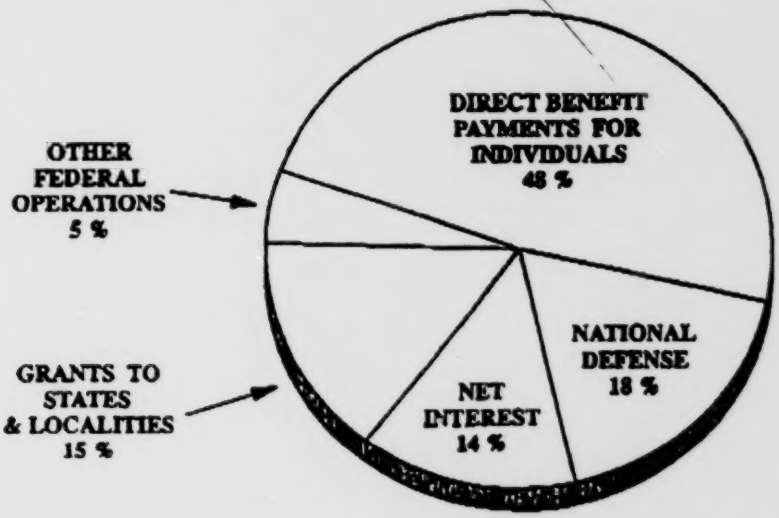
THE FEDERAL GOVERNMENT DOLLAR

FISCAL YEAR 1995 ESTIMATES

WHERE IT COMES FROM...



WHERE IT GOES...


DIRECT BENEFIT PAYMENTS FOR INDIVIDUALS 48 %
OTHER FEDERAL OPERATIONS 5 %
NATIONAL DEFENSE 18 %
GRANTS TO STATES & LOCALITIES 15 %
NET INTEREST 14 %

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THE FEDERAL GOVERNMENT DOLLAR
FISCAL YEAR 1995 ESTIMATES

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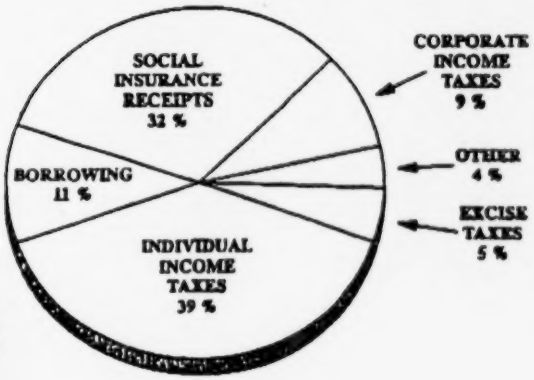

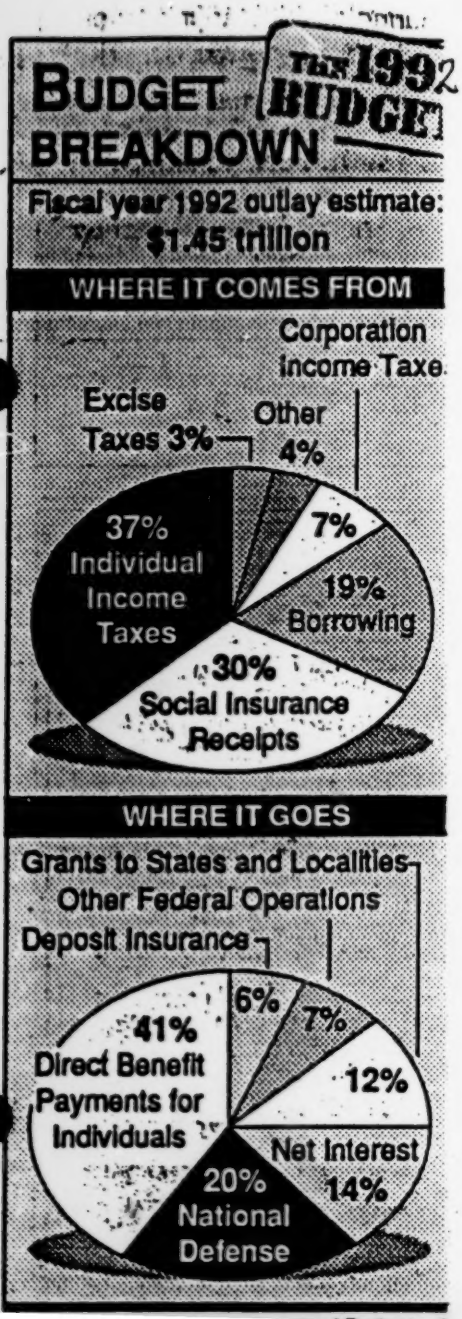

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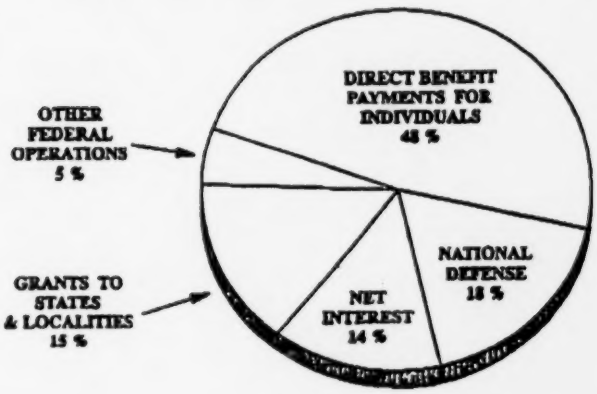
DIRECT BENEFIT PAYMENTS FOR INDIVIDUALS 48 %
OTHER FEDERAL OPERATIONS 5 %
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GRANTS TO STATES & LOCALITIES 15 %
NET INTEREST 14 %

REVENUE SOURCE		FY 1993 COLLECTIONS (IN MILLIONS OF DOLLARS)
Personal Income Tax		$4,226.6
Sales and Use Tax		3,773.7
Corporation Franchise Tax		801.4
Public Utility Excise Tax		615.3
Cigarette Tax		248.5
Carbonated Beverage Tax		18.3
Alcoholic Beverage Taxes		69.1
Other Taxes:		
Domestic Insurance Tax	$48.2	
Estate Tax	75.4	
Foreign Insurance Tax	236.9	
Horse Racing Tax	2.4	
Intangible Property Tax	4.9	
Total		$367.8
Other Revenue:		
Earnings on Investment	$17.4	
Liquor Profits	56.5	
Miscellaneous	193.5	
Total		$267.4
GRAND TOTAL		**$10,388.1**

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EXPENDITURE CATEGORY		FY 1993 EXPENDITURES (IN MILLIONS OF DOLLARS)
Primary & Secondary Education		$3,189.0
Higher Education		1,643.1
Human Services:		
Public Assistance	$2,537.0	
Mental Health & Retardation	700.3	
Miscellaneous	147.9	
Total		$3,385.2
General Government:		
Transportation	$33.5	
Environ. & Natural Resources	88.9	
Economic Development	77.1	
Miscellaneous	255.2	
Total		$454.7
Property Tax Relief		716.6
Justice and Corrections		832.7
Other Expenditures		117.3
GRAND TOTAL		**$10,338.6**

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Financial Data -- General Operating Fund

1992-93 Revenue	Amount	Percent
❑ Local taxes	$5,836,710	88.39
❑ State sources	598,717	9.07
❑ All other sources	168,247	2.54
Total	$6,603,674	100.00

1992-93 Expenditures	Amount	Percent
❑ Instruction	$5,020,052	74.10
❑ General control	634,590	9.37
❑ Building maintenance	858,886	12.68
■ Pupil transportation	110,882	1.64
❑ Extracurricular activities	150,257	2.21
Total	$6,774,667	100.00

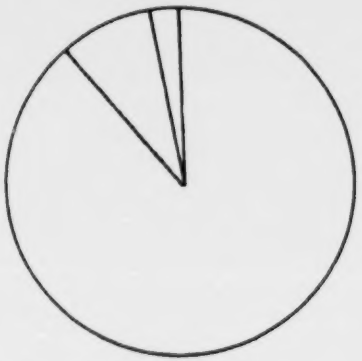
■■■

Message from the Treasurer: *Increased demands on the district's resources come from many sources. Inflation and unfunded government mandates are primary among them. State and federal lawmakers have imposed several new measures without providing money for their implementation.*

We were grateful and relieved that the citizens of St. Bernard and Elmwood Place voted to renew the five-year levy that will continue to provide $1.05 million per year, starting in January 1994. We face an uncertain future, however, regarding other sources of funding, with education reform facing the state legislature and cost-cutting being performed by major industrial taxpayers.

Personnel comprises about 80 percent of the district's expenditures. After years of trimming in other areas, such as in administration and among classified employees, the district had to make the painful decision to cut back on instructional staff. The number of teacher aides has been decreased for 1993-94.

The school district has always managed its money conservatively while providing a quality education for its students and their special needs. We pledge to continue to do so.



1992-93 Revenue

1992-93 Expenditures

Auxiliary services

Roger Bacon $267,358
St. Clement 97,344

St. Bernard-Elmwood Place is responsible for distributing state funds to the private schools within the school district boundaries. Auxiliary services provided by the funds include speech therapy, remedial math and reading, psychological services, and counseling.

Current property valuation used for assessing taxes

Real estate	Amount	Percent
Commercial	$ 8,912,160	4.03
Industrial	24,783,520	11.22
Residential	37,132,400	16.81
Public utilities	24,520	0.01

Personal property
(tax paid on business equipment & inventory)

Tangible	$137,263,350	62.17
Public utilities	12,711,740	5.76

Total valuation $220,827,690

Top Taxpayers in District

Procter & Gamble
Henkel Corp.-Emery Division
PMC Specialties Group Inc.
X-Tek Inc.
Central Steel

Current millage rate for operating expense: 28.59

Bond indebtedness as of 7-1-93

Date issued 1974
Date due 1998
Purpose ..... Construction of St. Bernard Elementary and high school
Amount ..... $1.3 million
Millage rate 1.31

St. Bernard-Elmwood Place Schools
105 Washington Ave.
St. Bernard, OH 45217
Robert Carroll, superintendent
Judy Roll, treasurer
641-2020

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GEOMETRY: SPATIAL SENSE AND MEASUREMENT

For many adults, geometry is one math topic that immediately makes sense to them and gives them confidence in their ability to learn. It is also true, however, that many adults associate geometry, like algebra, with failure. Measurement, a foundation skill for geometry, is also an essential life skill, one that adults use in many different but familiar contexts.

Measurement is not an end in itself. It is a tool used in many contexts; home, work, and community. We measure many different attributes of physical objects and time in many different ways in many different contexts. **Measurement is essential to our sense of ourselves and our orientation to the world.** Because measurement is used so often and in so many contexts, many learners have great confidence in their measurement skills. For ESL learners, teaching measurement is very important as a cross-cultural component of mathematics and second language learning, since many of these learners have use the metric measurement system much more than the U.S. system. **Measurement skills can be critically important.** Time management is another critical measurement skill.

Some adult learners identify geometry with failure. Other **learners recognize their excellent everyday skills in geometry, although they may or may not use the term "geometry" in relation to these skills.** Some adult learners don't see geometry as useful, however, geometry is and can be related to all aspects of life: home, school, work and community. Geometry and spatial sense can be used to describe the physical world.

IMPLICATIONS FOR LEARNING AND TEACHING

We must use exact and estimated measurements to describe and compare phenomena to increase the understanding of the structure, concepts and process of measurement. Despite the fact that competence in measurement is vital, some adult learners have difficulty selecting and determining appropriate units of measure as well as appropriate tools of measurement. Concrete activities with non-standard and standards units help learners develop an understanding of the many measurable attributes of physical objects (length, time, temperature, capacity, weight, mass, area, volume, and angle). This is the natural way of building a vocabulary for measurement, and for comprehension of what it means to measure.

We must address the impact of measurement skills on self-efficacy and

self-reliance. Math is everywhere and to be independent and survive on a limited budget one needs to be able to do things oneself and find the best values along the way.

Measurement skills should be extended to concepts areas such as volume, proportion, and problem solving.

We must increase the awareness of acceptable tolerances (margins and upper and lower limits) and the consequences of being withing and outside of these tolerances. In the workplace, everything is measured. Someone has to understand what upper and lower limits are, and how to input data. Much is computerized but the results are only as good as the information inputted.

The place to start is the learner's strengths; instruction must be practical and useful for learners to overcome their fears regarding geometry. Opportunities must be provided for learners to make connections between instruction and real-life situations common to their lives.

Finally, it is necessary to focus on hands-on problem solving and to give special attention to developing spatial sense in order for learners to develop an understanding of geometric principles. Spatial reasoning includes not only geometry, but measurement and the ability to visualize. It is often the visual and concrete models that can help people understand and learn what we want to teach about number and statistics. We must realize that this kind of reasoning, this part of mathematics, often helps students who have talents in this direction realize and accept that they do have mathematical potential.

Title: Celsius Temperature

Materials: Celsius thermometers, worksheet (attached).

Target Audience: Basic math skills.

Type of Setting: Small or large group, individual.

Activity Description:

1. Instructor develops the concept of Celsius temperature (e.g. 0°C is the freezing point of water and 100°C is the boiling point of water).

2. Students estimate Celsius temperatures of locations listed on worksheet.

3. Students place a thermometer at each location and leave it there for about 1 hour.

4. Students record and compare actual Celsius temperatures.

Evaluation: This hands-on activity will help students develop an understanding of the Celsius temperature scale.

Modifications: Other temperature-sensitive locations can be substituted depending on your particular classroom setting.

Celsius Temperature Worksheet

Directions:

Estimate each temperature in Celsius degrees. Place a thermometer in each location, leave it there for about an hour, then check and record actual temperature.

	Estimated temperature	Actual temperature
1. On a tabletop	_____	_____
2. On a windowsill	_____	_____
3. In the refrigerator	_____	_____
4. In the freezer	_____	_____
5. In your shirt pocket	_____	_____
6. Outside	_____	_____
7. On the wall	_____	_____
8. Near a heat source	_____	_____

Title: Metric Fill-Up

Materials: Metric measuring cups or graduated cylinders; sand; an assortment of household containers such as coffee cup, drinking glass, soft drink bottle, gallon jug.

Target Audience: Very basic math skills.

Type of Setting: Small group, one-on-one, or individual.

Activity Description:

1. Students first estimate the capacity of the container.
2. Students fill the container with sand and note actual capacity.
3. Students calculate the difference between their estimate and the actual capacity.

Evaluation: This activity helps students develop an understanding of metric units of capacity.

Modifications: This activity could become a competition; the student (or team) whose estimates are most accurate is the winner. Also, this concept could be modified for measurements of length or weight.

Title: An Apple for the Teacher

Materials: 1000 ml graduated cylinder of water and an apple for each group.

Target Audience: Intermediate to advanced math skills.

Type of Setting: Small or large group.

Activity Description:

Volume:

1. Instructor introduces the concept of "displacement" and how the volume of water displaced by the apple is equal to the volume of the apple.

2. Students explore the concept using the attached worksheet.

Weight:

1. Instructor develops the concept that an object that floats in a liquid displaces an amount of liquid equal to the weight of the object. Tell students that they will be measuring the weight of the apple without using a scale.

2. Students explore the concept using the attached worksheet.

Evaluation: This activity explores two important measurement topics: volume of an object by water displacement; and determination of weight by volume of water displaced. It is important for the instructor to develop these ideas for the class.

Resources: Let's Measure Metric, Ohio Dept. of Education, 1975

Modifications: This activity can be expanded to include other objects which will float in water.

An Apple for the Teacher Worksheet

Volume

1. Fill the beaker about 2/3 full of water. Record the level of the water.

   Water level 1 = _____ ml

2. Place the apple in the beaker, taking care not to spill any water. Using a pencil, hold the apple just below the surface of the water. Record the water level.

   Water level 2 = _____ ml

3. Calculate the volume of the apple by subtracting water level 1 from water level 2.

   Water level 2 - water level 1 = ____ ml = volume of the apple

4. Explain why the difference between the two water levels is the same as the volume of the apple.

Weight

1. Estimate the weight of the apple. _____ g

2. Fill the beaker about 2/3 full of water. Record the level of the water.

   Water level 1 = _____ ml

3. Place the apple in the beaker, taking care not to spill any water. Let the apple float on the surface of the water. Record the water level.

   Water level 2 = _____ ml

4. Calculate the volume of water displaced.

   Water level 2 - water level 1 = _____ ml

5. Given that 1 ml of water weighs 1 gram, what is the weight of the apple? How does this compare with your estimate?

   Weight of the apple = _____ g

Title: Metric Trail Mix

Materials: Metric measuring cups, small mixing bowl, trail mix ingredients.

Target Audience: Very basic skills.

Type of Setting: Small group or individual.

Activity Description:

Students make individual servings of trail mix using the following recipe:

125 ml shelled peanuts	60 ml M&M's
80 ml raisins	30 ml coconut

Thoroughly mix ingredients in a small bowl. Enjoy!

Evaluation: This hands-on activity helps the student develop familiarity with metric units of capacity. Students with very basic reading and math skills will be able to experience success in a practical classroom activity.

Modifications: Other recipes which lend themselves to classroom use may be substituted. If an oven is available, baking temperatures should be given in Celsius degrees.

Title: Hands Down

Materials: Masking tape strip about 2.7 meters long, meter stick, decimeter square, worksheet (attached).

Target Audience: Beginning to intermediate math skills.

Type of Setting: Pairs or small group.

Activity Description:

1. Instructor attaches masking tape strip to classroom wall or table.

2. Students cut out the decimeter square.

3. Students work in pairs or very small groups following the directions given on worksheet.

Evaluation: This activity demonstrates the need for standard units of measurement. Students also learn that accuracy is increased by use of smaller standardized units which are more suited to the particular measurement task.

Resources: Let's Measure Metric, Ohio Dept. of Education, 1975

Hands Down Worksheet

Directions:

1. On the wall or table, you will find a long strip of masking tape. Find the length of this strip by measuring it with your hands.

   Strip length = _____ hands

2. Compare your answer with your partner's. Are the answers the same? If not, why not?

3. Now use the meter stick to measure the strip. It is called a meter stick because it is 1 meter long.

   Strip length = _____ meters

4. Compare your answer with your partner's. Are the answers the same? Why or why not?

5. Now use the decimeter square to measure the strip. Each side is 1 decimeter long.

   Strip length = _____ decimeters

6. Compare your answer with your partner's. Are the answers the same? Why or why not?

7. Compare your answers for the strip length in questions 3 and 5.

   _____ meters = _____ decimeters

8. How many decimeters are the same as one meter?

   _____ decimeters = 1 meter

Title: How much time is it? Devolping the concept of time.

Materials: An alarm clock or kitchen timer.

Audience Targeted: Basic Literacy

Type of setting: Classroom, small group or one-on-one

Activity:

1. Discuss how long various times are: second, minute, hour, day.

2. Tell students you are going to measure various lengths of time. Set the alarm clock for a period of time. Tell the students how much time it was set for. Go on with your lesson.

3. When the alarm rings, discuss what occurred in the time frame. Make estimates, how long does it take to do an activity.

Evaluation: This is a good activity to get a feel for different time periods.

Recommended resources: Measurement Investigations, by Tamara J. Dream and Randall J. Souviney.

Modifications:

1. As a pre-activity have pairs of tasks such as tie your shoe and write your name written on 3x5 cards. Have students guess which takes longer. Then one student does one task and the other does the other task to find out which one takes longer. Do the tasks again but measure how much time each takes with a watch.

2. Set the alarm clock for an amount of time but don't tell students how long. When the alarm rings students guess how much time passed.

3. Tell students to close their eyes for a specified amount of time, one minute, five minutes. Have students raise their hand when they think the amount of time is up. Record whose hand goes up when. When all hands are up have the class open their eyes. Show them the guesses. Practice this to get an internal feel for time.

Title: Snake and Ball: Developing the concept of mass.

Materials: Clay and a balance.

Audience Targeted: Basic literacy

Type of setting: Class, small group and one-on-one.

Activity:

1. Divide clay into equal pieces. Use the balance to ensure each is equal to the rest.

2. Give each student two pieces of clay. Let them balance them on the balance to ensure the mass is equal.

3. Have students roll one piece into a ball and the other piece into a snake.

4. Ask if the two pieces weigh the same or if one is now heavier.

5. Use balance to ensure they are still the same.

6. Have students experiment rolling clay into different shapes and weighing on the balance.

Evaluation: Good tactile, kinesthetic activity. Helps students understand that things can be different shapes and have the same mass.

Recommended resources: Measurement Investigations, by Tamara J. Dream and Randall J. Souviney.

Modifications: Try weighing different density objects that are the same size.

Title: Straight line, crooked line: Developing the concept or length,

Materials: Sidewalk chalk, clothes line, yard or meter sticks.

Audience Targeted: Basic Literacy.

Type of setting: Classroom, small group, one-on-one

Activity:

1. Draw curved and crooked lines of various lengths on the sidewalk. Different shapes may also be drawn.

2. Have students lay clothes line along a figure, marking the starting and ending points.

3. Measure clothes line with yard stick. Record.

4. Have students guess if other lines are longer or shorter than the first one. Record guesses.

5. Use the same method to measure the other lines. Determine which are longer/shorter than first line.

6. Rank lines from longest to shortest.

Evaluation: Great kinesthetic activity when students need to move to learn, or have extra energy. Fun treat to go outside on a nice day. Shows how length can be the same even if lines are not straight.

Recommended resources: Measurement Investigations, by Tamara J. Dream and Randall J. Souviney.

Modifications: Can be done on a smaller scale indoors with paper and rulers.

Title: Easy to Read Ruler

Materials: One inch squares of cardboard or some other heavy material (twelve per student). Twelve inch strips of cardboard and markers

Audience Targeted: Basic math

Type of setting: Classroom, small group or one-on-one.

Activity:

1. Have students place squares side by side on objects to be measured. Books are a good size.

2. Have students count the number of squares it take to be the same length as the object.

3. Have students measure the cardboard strip using the squares.

4. Discuss how one can use blocks or use a stick with blocks marked off on it to measure.

5. Have students mark off blocks on cardboard strip. Have students color each block on the cardboard strip a different color. Or, paste blocks on to strip if they are of different colors.

6. Students need only to count the blocks that line-up with the object they are measuring to give the inches.

Evaluation: This "easy to read ruler" gets rid of all the extra lines which can be confusing to someone learning to use a ruler. The colored in blocks also help the student to understand she is counting units when measuring, not just looking at the lines. This ruler is very useful for people with poor eye sight or visual dyslexia.

Recommended resources:

Modifications: If students are more advanced, or begin asking how to measure if the object being measured falls in the middle of a block, the concepts of half an inch and quarter of an inch may be introduced.

Title: Measurement Box: Developing the Concept of Length

Materials: Largecard board box filled with materials of various lengths: pencil, tie, rope, straw, paper clips, ribbons, belt, extension cord, etc. Standard ruler, yard stick, metric ruler, meter stick (depending upon what units you are working on). 3x5 cards.

Audience Targeted: Very basic math skills.

Type of setting: Classroom, small group or one-on-one.

Activity:

1. Let students explore the objects, ask them to describe objects to classmates.

2. Ask students to compare the lengths of objects. (Which is shorter?)

3. Ask students to put objects in order from shortest to longest.

3. Ask students to compare using another item as a nonstandard measure. (How many straws does it take to make an extension cord?)

4. Ask students to measure items using a ruler.

5. These and other questions can be written on cards so students can explore items at their own pace.

Evaluation: This is a good hands on activity. It encourages students to understand the concept of length before measuring with a ruler. It allows the tutor to observe the student's current skills and knowledge before beginning to teach.

Recommended resources: Up the Math Ladder, Lynn Molyneux.

Modifications: This same idea can be used to create a weight box, volume box or other measurement box

TITLE: Water, Water, Everywhere!

OBJECTIVES: Students will be able to use various liquid measures into other measures.

MATERIALS LIST: Empty plastic gallon milk jugs, empty plastic quart milk jugs, empty plastic pint milk jugs, plastic 8oz. Cup measure, funnels, water, paper, pencil, markers.

TARGET AUDIENCE: Lower level ABLE

INSTRUCTIONAL GROUP SIZE: Small(3)

ESTIMATED TIME: 20 Minutes

ACTIVITY DESCRIPTION: Have each container marked A, B, C, D. Introduce each container and have students estimate how many of the small containers of water (A), it would take to fill container. Place estimate on graph on board (see attached sheet).Ask how many of the containers marked B it would take to fill the container marked C, and put the guess on the graph. Repeat this process with each of the containers. Next have the students divide into groups and have them fill container A (8oz. Cup) with water and pour the water into container B (pint). Record the number of cups it takes to fill the container on the graph on the board. Repeat the process with each container . Conclude activity with discussion of the graph and comparison of results with estimates.

LIQUID MEASURE GRAPH

	PINT		QUART		GALLON	
	ESTIMATE	ACTUAL	ESTIMATE	ACTUAL	ESTIMATE	ACTUAL
CUPS						
PINTS						
QUARTS						
GALLONS						

TITLE: Inches, Feet, and Yards

OBJECTIVES: Students will be able to use a tape measure to accurately make sure the length and width of a room. Students will be able to use graph paper to show relationships between an actual square foot and a square on the graph paper.

MATERIALS LIST: Tape measure(s), paper, overhead projector, graph paper, pencils, graph transparency.

TARGET AUDIENCE: ABLE Students

INSTRUCTIONAL GROUP SIZE: Small or large group

ESTIMATED TIME: 30 Minutes

ACTIVITY DESCRIPTION: Teams of three students are given a tape measure and asked to measure the length and width of the room. One person acts as the recorder . When measuring is completed, graph paper is given to each student. The teacher will work on the overhead transparency as students work on theirs to draw a floor plan of the classroom. More ABLE students may use the tape to locate the placement of file cabinets, tables, etc. These would be included in the scale drawing. The graphs can then be used to answer questions about perimeter and square feet.

RESOURCES /SOURCES USED: Measure Up, by Charles H. Kahn, Sylvia K. Herring, and Robert Tong. Fearon/Janus/Quercus, Pub. Contemporary's Critical Thinking With Math, Contemporary Books.

QUESTIONS FOR "INCHES, FEET, YARDS"

1. Acme Super Store has vinyl floor covering on sale this week. The covering comes in the same width as the room. How many yards of covering will you need to cover the floor of the classroom?

2. Home Corp has carpet advertised for $5.99 a square yard. If 9 square feet make one square yard, how many square yards of carpet will you need to purchase to cover the classroom floor?

3. What will be the cost of the carpet in question #2?

4. After the new floor is laid, we are going to put molding around the room. Using your graph paper drawing, determine how many feet of molding will be needed. Molding sells for 69¢ a foot. How much will the molding cost?

5. What will be the total cost of the carpet in #3 and the molding in #4?

TITLE: How Does Your Garden Grow?

OBJECTIVES: Students will demonstrate the correct use of a tape measure. Students will use graph paper to draw a diagram of their yard. Students will compute area and perimeter accurately.

MATERIALS LIST: Graph paper, tag board, tape measure, string, paper, pencils.

TARGET AUDIENCE: Mid-level ABE students.

INSTRUCTIONAL GROUP SIZE: Small or large group

ESTIMATED TIME: Two or more class periods, could be used after "Inches, Feet, Yards.

ACTIVITY DESCRIPTION: In class have students make a yard stick out of tag board or string if students do not have access to a tape measure. Have students measure their yards at home and bring the measurements to class. Use the graph paper to draw a scale model of their yards. Have students use the graph of their yard to answer the questions on their attached worksheet.

RESOURCES/SOURCES USED: Consumer Math Success Kit, J. Weston Walch, Pub.

ACTIVITY QUESTIONS FOR "HOW DOES YOUR GARDEN GROW?"

1. ACME PLANT STORE HAS GRASS SEED ON SALE FOR $2.99 A BOX. ONE BOX WILL COVER 400 SQUARE FEET OF LAWN. USING YOUR GRAPH, HOW MANY SQUARE FEET OF LAWN DO YOU HAVE IN YOUR YARD? HOW MANY BOXES OF GRASS SEED WILL YOU NEED TO PLANT YOUR LAWN?

2. YOU WISH TO PUT A FENCE AROUNDD YOUR BACK YARD TO KEEP IN YOUR DOG. HOW MANY FEET OF CHAIN LINK FENCE DO YOU NEED TO BUY?

3. CHAIN LINK FENCE SELLS FOR $1.99 A YARD. HOW MANY YARDS OF FENCING WILL YOU NEED? HOW MUCH WILL IT COST TO FENCE YOUR YARD?

4. YOU WANT TO PUT A FLOWER BED IN THE FRONT YARD OF YOUR HOUSE. THE BED WILL BE 8FEET BY 10 FEET. YOU WANT TO SURROUND THE BED WITH EDGING. THE EDGING COMES IN ROLLS 10 FEET LONG. WILL 3 ROLLS BE ENOUGH?

5. IF THE EDGING COSTS $.98 A ROLL, HOW MUCH WILL YOU SPEND FOR THE EDGING?

6. YOU NEED TO KNOW HOW MUCH TO BUDGET FOR YOUR YARD. IF YOU SPEND $20. FOR FLOWERS FOR THE FLOWER BED, HOW MUCH WILL YOU HAVE SPENT FOR ALL YOUR YARD IMPROVEMENTS? (GRASS SEED, FENCING, EDGING, AND FLOWERS)

Title: Measuring Fences - Understanding Perimeter

Materials: Squares, rectangles, and triangles of different sizes cut from cardboard or construction paper, or a copy of Handout 1; two sizes of paperclips

Audience: Adult learners with low to intermediate math skills

Setting: Classroom or tutor situation; group or one-on-one

Activity: In a discussion with students, relate perimeter to a fence in that they both surround a space on all sides; learners are more likely to remember to include all sides when finding perimeter if you continually refer to the fence concept.

Provide students with the figures of differing sizes and about 20 of the smaller paperclips; have them determine how many paperclips it takes to go around each figure. Compare findings to verify that all students are measuring correctly. Make the connection that what they have measured is the perimeter of the figure.

Next, give learners about 10 jumbo paperclips and ask the following questions:

1.) Will it take the same number of the larger paperclips to make the perimeter of the figures as it did the smaller clips? (no)

2.) Will it take more or fewer of the larger clips? (fewer)

Tell students to prove their answer to question 2 by using jumbo clips to measure the perimeter of one of the figures. Then ask:

3.) Why did it take fewer large paperclips than smaller paperclips to make the perimeter of the figure? (allow all answers; verify the correct answer with the continuation of the exercise)

Show the class a well used pencil and an unsharpened pencil, then ask:

4.) Would it take more of the new pencil or more of the used pencil to measure the perimeter of the top of my desk? (more used pencil because it is smaller)

Repeat this using two sizes of other objects (straws, toothpicks, pens, craft sticks) and measure other objects in the room until the learners conclude that it always takes fewer larger units than smaller units to measure the same distance. Conclude by asking the same question about inches

and feet; feet and yards; and any other standard units desired.

Evaluation: This hands-on activity reinforces the fact that perimeter measures the distance around a figure and that it takes fewer large units than small units to measure equal distances.

Modification: Use actual items in the classroom to measure. After the activity, measure the perimeter of the classroom using a ruler, then repeat using a yard stick. Discuss the relationship of the outcomes with the number of feet in a yard.

Title: Making Fences - Introducing the Formula for Perimeter

Materials: About 20 straws for each pair of students (if space is limited, use bar straws or craft sticks)

Audience: Adult learners with low to intermediate math skills

Setting: Classroom or tutor situation; group or one-on-one

Activity: A. Perimeter of a square

Distribute about 20 straws to each pair of students; ask them to use some of their straws to make a square. Walk around to ensure that all students are proceeding correctly. Then ask:

1.) How many straws did you use to make your square? (answers may vary)

Connect this to the fact that the number of straws used to make the square is the perimeter of the square. Next instruct learners to make a square with a perimeter of 8 straws; check that all have succeeded. Then ask them to make a square with a perimeter of 10 straws. They will not be able to comply unless straws are cut which is not allowed. Ask:

2.) Why couldn't you make a square with a perimeter of 10? (accept all answers and verify the correct answer by continuing the activity)

Continue the activity by requesting that learners make squares with other perimeters, mixing in some that are not possible. (4, 6, 12, 15, 16, 18, 20) Learners should come to the conclusion that all possible perimeters are multiples of four. Introduce the formula for the perimeter of a square, $P = 4s$ (perimeter equals four times the side of the square).

B. Perimeter of a rectangle

Ask students to make a rectangle using some of their straws.

Then ask:

3.) How is the rectangle different than the squares you made? (it is longer one way than it is the other way)

Repeat the activity above instructing students to make rectangles of various perimeters. The smallest perimeter using whole straws is six, and all perimeters will be multiples of two. Lead the students to this discovery through the construction of the rectangles.

(continued)

Introduce the formula for the perimeter of a rectangle, P = 2l + 2w (perimeter equals two times the length plus two times the width). It is because you always have to multiply the length and width times two that the perimeter is a multiple of two. (This is true only when using whole units as dimensions.)

C. Perimeter of a triangle

Repeat the activity having the students construct triangles.

Lead the students to discover that there is no requirement for the perimeter of a triangle except that there be only three sides. Introduce the formula for perimeter of a triangle, P = a + b + c (perimeter equals side a, plus side b, plus side c.)

Evaluation: A hands-on activity to discover the origin of the formulas for perimeter. This type of discovery usually helps the student to retain the formulas in memory.

Modifications: This should be accomplished in a series of classes beginning each new session with a review of concepts already learned. If the class is high intermediate, the concepts of the right triangle could be explored (ie. the side opposite the right angle is always the longest).

Title: Two Bits Square - Understanding Area

Materials: Quarter-size circles and one-inch squares of heavy paper or cardboard; a copy of Handout 1 for each pair of students

Audience: Adult learners with low to intermediate math skills

Setting: Classroom or tutor situation; group or one-on-one

Activity: Begin by distributing copies of Handout 1 and about 25 circles and 25 squares to learners. Then ask:

1.) How many quarters do you think would cover figure A? (accept all answers; verify correct answer as activity continues)

Next have learners actually cover figure A with the quarter size circles to verify correct number. Repeat with figures B and C, having learners first estimate how many before covering the area. Explain that the area is the covering of the surface of a figure. Then ask:

2.) How many of the one-inch squares do you think it would take to cover figure A? (accept all answers; verify answer as activity continues; it will take the same number of squares as circles)

Have learners cover figure A with one-inch squares to verify the correct number. Repeat with figures B and C, estimating the number before covering figure. They should discover that the number of quarters is the same as the number of square inches.

Evaluation: This activity can help learners gain a reference for estimating square inches by visualizing quarters.

Modification: Have students estimate how many quarters would cover items on their desks or in the class. Intermediate to high level learners could perform the activity using figures D and E or with figures on Handout 2.

Title: Grazing the Pasture - Measuring Area

Materials: Handout 1; a transparency of the one-inch grid sheet for each pair of learners; surfaces or faces of several classroom items

Audience: Adult learners with low to intermediate math skills

Setting: Classroom or tutor situation; group or one-on-one

Activity: Discuss with learners that area is like a pasture or vacant lot: it covers a flat space. For that reason it is measured with a flat measurement such as square inches.

Have learners lay transparencies over figure A of Handout 1 and count the number of squares it takes to cover the area. Reinforce the fact that area is always measured in square units. Learners can then measure the area of figures B and C. More advanced learners can find the area of figures D and E (the triangle and circle). The transparencies can be written on with china markers or overhead markers to help students count squares or outline the figures.

Let students use the transparencies to find the area of some items in the classroom such as book covers, window panes, table tops, etc.

Evaluation: This hands-on practice reinforces the fact that area covers a flat space, not a linear distance, and must be measured in square units.

Modification: Measure area using a transparency of the half-inch square grid as a follow up activity. Ask learners first if they expect it to take more or fewer half-inch squares than one-inch squares to cover each area. After they discover that it takes more half-inch squares to measure every area, reinforce that it always takes fewer large units than small to cover the same area.

On a clear shower curtain liner, have students make a square-foot grid using a T-square, tape measure, and permanent markers. Measure the area of large classroom surfaces available such as table tops, blackboards, walls, or floors. (This grid can later be used to teach latitude and longitude by numbering the lines.)

Title: Greener Pastures - Introducing the Area Formula

Materials: Handout 1; square-inch grid transparencies; rulers

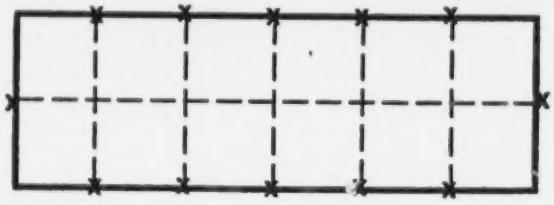
Audience: Adult learners with low to intermediate math skills

Setting: Classroom or tutor situation; group or one-on-one

Activity: This activity should follow Grazing the Pasture. After measuring many surfaces using the transparency, the learner needs to understand that it is not the simplest nor the conventional way to find area. It would be cumbersome to carry with you sheets to lay on surfaces and tedious to have to count the squares.

Ask students to measure each side of figure A and mark off each inch. Next have them connect the marks opposite each other. (You may have to show an example of this on the board.)

example:



Then ask:

1.) How many squares are in figure A? (12)

2.) What was the area when you measured it with the transparency grid? (12 square units (or inches))

After naming the longer side the length and the shorter side the width, ask:

3.) How many inches did you mark off on the length (across the top) of figure A? (6)

4.) How many inches did you mark off on the width (along one side) of figure A? (2)

Instruct students to multiply the number of inches across the top of figure A by the number of inches along the side of figure A. Ask:

5.) What number do you get when you multiply these two numbers? (12)

6.) What conclusion can you make from this? (that to find area you can multiply the length of the rectangle by the width of the rectangle)

Repeat this process with figures B and C. You have just proven the formula for the area of a rectangle, A = lw (area equals length times width).

Title: Half a Pasture - Proving ~~the~~ "a" Formula for Area of a Triangle

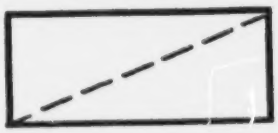
Materials: Two copies of Handout 1; rulers; scissors; square inch grid transparencies per pair of students

Audience: Adult learners with low to intermediate math skills

Setting: Classroom or tutor situation; group or one-on-one

Activity: Have learners find the area of figure B, then draw a diagonal line from one corner to the opposite corner in the figure. You may need to show an example on the board.

example:



Tell learners to cut out figure B. When they have done this, have them cut on the diagonal line. Then ask:

1.) What do you have now that you have cut along the diagonal line? (two triangles)

2.) How do the triangles compare in size? (they are the same)

Lead students to see that they have cut the rectangle in half; therefore, the area of each triangle is half of the area of rectangle B by asking:

3.) What is the area of one of the triangles? (6 square inches)

Let students use transparencies to confirm the area of the triangle.

Going back to the uncut copy of Handout 1, have students rename the width the base (because the figure sits on it) and the length the height (because that is how tall the figure is). Ask:

4.) What number do you get if you multiply the base times the height? (12)

5.) How does this compare with the area of figure B? (it is the same)

6.) Why is it the same? (because the base and height are the same as the length and width, and area equals length times width)

7.) What is half of this area? (6 square inches)

8.) How does this compare with the area of one of the triangles that you made from figure B? (it is the same)

9.) Why? (because one triangle is half of the rectangle)

Introduce the formula for the area of a triangle, A = 1/2 bh (area equals half of the base times the height OR area equals one half times the base times the height).

Evaluation: This hands-on proof should make it easier for learners to remember to use the one-half in the formula for the area of a triangle; this is often a problem for students.

Modification: It may be necessary to repeat the activity using figures B and C for some students to grasp the concept. Repeating the hands-on process is usually helpful for slower learners.

Title: Do Equal Pastures Have Equal Fences? - The Relationship Between Perimeter and Area

Materials: 12 square-inch tiles and copy of Handout 5 per pair of students

Audience: Adult learners with low to intermediate math skills

Setting: Classroom or tutor situation; group

Activity: Distribute 12 square-inch tiles to each pair of learners. Instruct learners to make a figure with an area of 2 square inches making sure that whole sides touch (example:)

Have students find the perimeter of their figure and fill in the appropriate numbers in the chart on Handout 5. At this point all areas and perimeters will be the same.

Ask students to make a figure with an area of three square inches. This could provide some variety in the look of the figures and in the perimeters. However, they may all have the same results. Students then add the information to their chart.

Continue to increase the area of the figure you ask the students to make up to twelve square inches in area, having them record the information on their charts each time.

Conclude the activity by making a classroom chart showing all of the results from all of the learners' figures. It should then be very clear that the same area does not mean the same perimeter.

Evaluation: This activity can inspire a lot of discussion about the shapes that can produce the same area. It also very effectively makes the point that same area does not mean same perimeter.

Modification: You can use a combination of squares and rectangle (doubles or triples of the squares used) and even right triangles for more advanced students.

This is also a great way to explore the multiplication facts. If you do not allow any shapes other than squares and rectangles, the lengths and widths will be the factors of the areas in every case.

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Title: Equal Pastures, Equal Fences? (Version 2)

Materials: Rectangular sheets of construction paper; scissors

Audience: Adults learners with math intermediate to high math skills

Setting: Classroom or tutor situation; group or one-on-one

Activity: Distribute one piece of construction paper to each learner. Have learners draw a diagonal line from one corner to its opposite corner, then cut on the line producting two triangles. Have them mark inches along the edges as a guide to determine perimeter.

Instruct each learner to construct as many figures as possible (3) by placing matching sides of the triangles together. They should draw a sketch of each figure and find its perimeter; then compare the perimeters. Be sure they realize that the area of every figure is the same because that one piece of paper was used.

The outcome should be that while the areas are the same, the perimeters are different.

Evaluation: This is a quick activity especially good for intermediate to high level students to show that the same area does not always mean the same perimeter.

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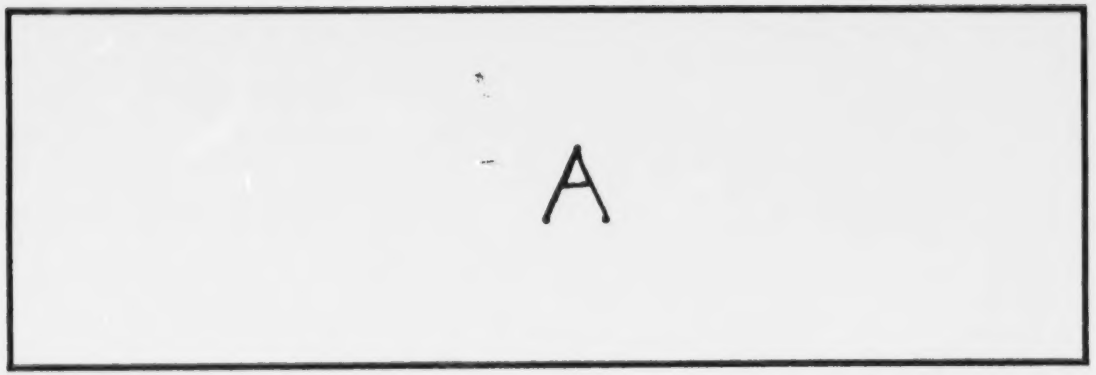
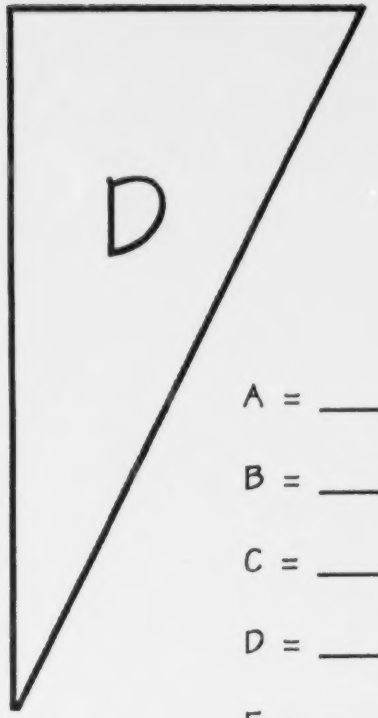




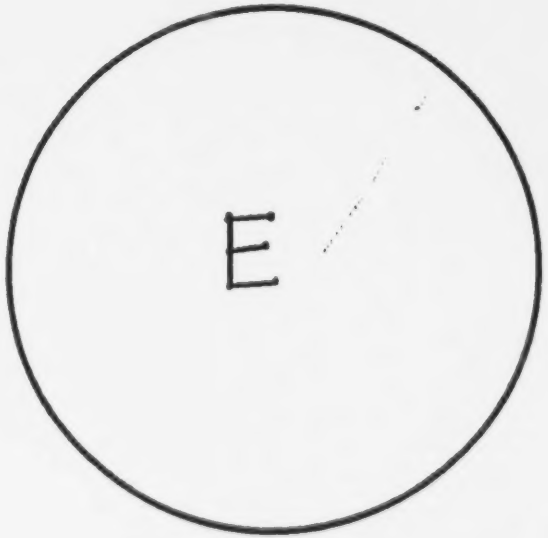
A = _____

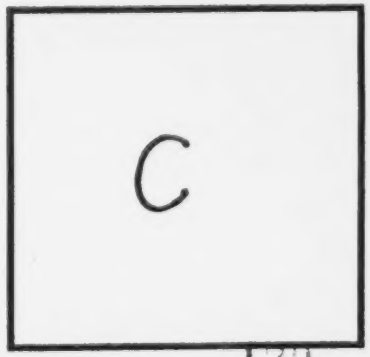
B = _____

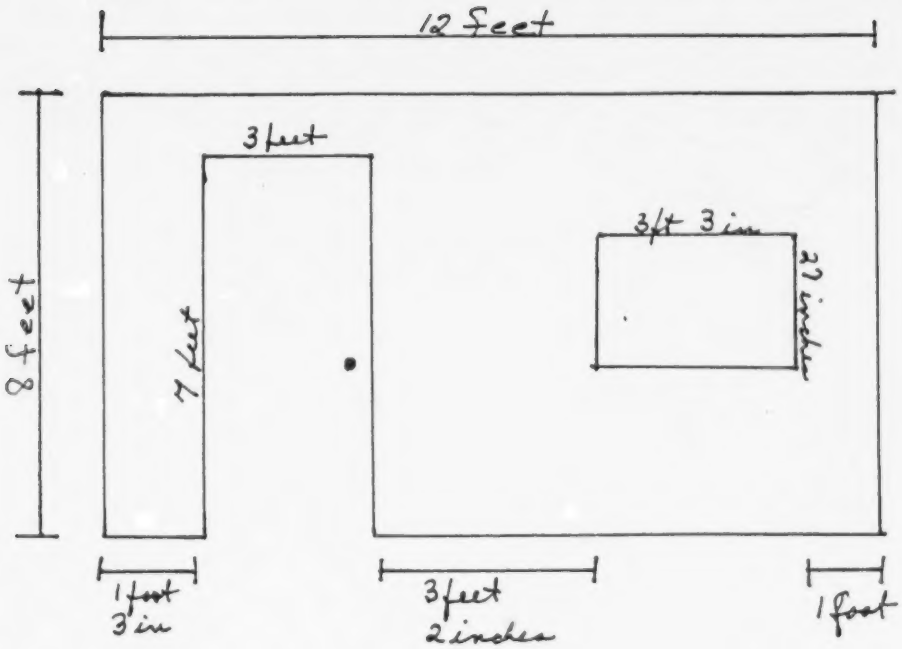
C = _____

D = _____

E = _____







What is the least number of rolls of wallpaper you will need to wallpaper the wall shown above? The wallpaper is sold in rolls 24 inches by 25 feet. You do not need to match a pattern but all seams must be up and down.

A. 1
B. 2
C. 3
D. 4
E. 5

Title: Post-It Note Area

Objective: To develop an intuitive understanding of the concept of area
To practice measuring "unit areas"

Materials: Post-it Notes (square pads)

Audience targeted/level: Literacy, pre-GED or GED

Type of setting: Classroom, small group or one on one

Time required: 20-30 minutes

Activity: Students should estimate the number of Post-It Notes it would take to cover a surface. Possible surfaces: notebook cover, folder, desk top, book, or table top. Next, use Post-It Notes to actually cover the area. In this way students can actually experiment with a **square unit**. Compare the actual number of Post-It Notes required with the estimate.

Questions: How do the estimate and the actual count of Post-It Notes compare?
What happens when Post-It Notes don't fit?

Evaluation: This activity gives students hands on experience understanding the concept of area and square units.

Recommended Resources:

Modifications: This same activity could be done with paper, scissors and glue. Objects in the classroom could be traced on newspaper. Students could cut squares of a determined size (not necessarily a square inch) from scrap paper. These squares could then be glued on the newsprint.

Title: Wrap, Wrap, Wrap!

Objective: To introduce students to geometry. To practice measuring skills. To understand the concepts of length, width, height, volume and surface area. To develop problem solving skills.

Materials: Rulers, tape, scissors, 15 small to medium size boxes per group (Small boxes are most desirable. Individual size cereal boxes, plastic cassette tape containers, earring boxes are recommended), and a sheet of 36" by 30" wrapping paper per group. (Rolls of paper can be cut to equal a similar quantity of paper. Large sheets of paper can be found at paper outlet stores.)

Audience targeted/level: Multi-level (I, II, III)

Type of setting: Students are grouped into three or four per group.

Time required: 1 1/2 hours, depending on the length of introduction to the concepts and formulas for volume and surface area.

Activity: All students are introduced to the concept and formula for volume and surface area. Students are then grouped into small groups of 3 to 4 students. Each group chose a person to lead, measure, cut and tape. The leader chooses a piece of wrapping paper. Then the teacher poses the problem: **"There's going to be a baby shower. You were chosen to buy all the gifts with the money that has been given to you by your classmates. You were so busy shopping that when you got home, you noticed you had hardly anytime to wrap the presents. Even worse, you discovered that you had 1 sheet of paper to wrap all the presents. That is your problem."** Students are advised that prizes will be given to the group that wraps the most presents and/or the group with the least waste.

Next the leaders come up, and one at a time, pick one box at a time until every leader of a group has 10 boxes. Be careful that a leader doesn't pick more than one. Leaders must take consecutive turns to be fair. Start wrapping. No splices are allowed. All sides of boxes have to be completely covered. After a group has wrapped at least 10 boxes, the leader may go up and choose another box to wrap. When that box is wrapped, the leader may choose another one, and so on, but only one at a time.

To measure the group who has the least waste, introduce the area formula and compare the waste of the groups.

Prizes should be given to the whole class as well as something extra for the winners.

Evaluation: This activity was lots of fun for the students. The group which won (14 boxes wrapped) in the test class was the group with the lowest level students.

Modifications: The problem could be changed to reflect the interests of the class.

Title: Tangram Unit Area

Objective: To develop an intuitive understanding of the concept of area.
To practice measuring in "unit areas"

Materials: Tangrams, Tangramath worksheets, pp. 24, 25, 62, 63, 64 and 65 or similar sheets. *See sample below*

Audience targeted/level: Literacy, pre-GED or GED

Type of setting: small groups, pairs or individuals

Time required: 20 minutes

Activity: Use the Tangramath worksheets and the tangrams to compare the sizes (areas) of two differently shaped drawings. Use the tangram small triangle to measure the areas of the other tangram pieces. Measure some areas using tangram triangles or squares.

Evaluation:

Recommended Resources: Tangramath, Creative Publications (available through Dale Seymour)

Modifications:

Title: Identify the Angles

Objective: To identify right, acute, and obtuse angles using pattern blocks

Materials: Pattern blocks for student use

Audience targeted/level: All levels

Type of setting: Small groups or one on one

Time required: 10 to 15 minutes

Activity: Using pattern blocks students will find a shape or shapes that has...
...only right angles
...only acute angles
...only obtuse angles
...find three shapes that have two acute angles and two obtuse angles
(identify which angles are acute and which are acute)

Evaluation: This was a fun activity for the students and a quick hands on way to identify types of angles.

Recommended Resources:

Modifications: A similar line of questioning could be used with tangrams.

Title: Angles, Angles, Angles!

Objective: To introduce the students to angle relationships.

Materials: Pattern blocks for the class

Audience targeted/level: ***All*** levels of ABLE students

Type of setting: This activity works well when done in pairs or small groups. It could be done individually.

Time required: 30 minutes

Activity: Introduce the concept of **complementary angles.** Find two pattern block shapes that have corners that make complementary angles when matched up. Use a shape with a 90 degree angle (the orange square) to prove your answer. How many different combinations of shapes will make complementary angles? (3)

Introduce the concept of **supplementary angles**. Find two pattern block shapes that will make supplementary angles when their corners are matched up. How many combinations can you find? (9)

Introduce the concept of **vertical angles**. Arrange four trapezoids from the pattern block set to show two intersecting lines. *(See drawing 1)* Use two green triangles lined up over the acute vertical angles to show they have equal measures. *(See drawing 2)* Two blue parallelograms lined up over the obtuse angles will demonstrate the equal measures of those angles.

Introduce the concept of **parallel lines cut by a transversal**. If another row of trapezoids is added to the previous drawing, a set of parallel lines cut by a transversal will be created. Using the green triangles and blue parallelograms to "measure" again, these relationships can be explored.

Evaluation: This activity was fun and interesting for the students.

Recommended Resources:

Modifications: The concepts of complementary and supplementary angles could be explored using tangrams but there are fewer combinations.

Title: 180 Degrees - Yes, No, or Maybe

Objective: To prove that the sum of the angles in a triangle is 180 degrees.

Materials: Paper, rulers, scissors and glue.

Audience targeted/level: ***All*** ABLE students, no matter what their math level

Type of setting: Group or individual activity

Time required: 20 to 30 minutes

Activity: Review the meaning of supplementary angles and straight angles. Review the various types of triangles. With paper, pencils and rulers the students will construct various types of triangles. In order to later identify the angles of the triangle students need to mark each corner or angle. Tear the triangle in three pieces so each piece contains an angle. *(Tearing the paper makes it easier to identify the original angles.)* The angles are then glued on another sheet of paper so the middle angle joins each of the other two at a side and the vertices meet at a point.

Discuss the shape that the three angles form. What does this mean? What can be concluded about the sum of the angles in different shaped triangles?

Evaluation: This hands-on activity makes the concept of the sum of the angles in a triangle very clear to the students. They really remember that there are 180 degrees in the sum of the angles.

Recommended Resources:

Modifications:

Title: Fun With Polygons

Objective: To understand polygons

Materials: Pattern blocks

Audience targeted/level: All ABLE levels

Type of setting: Small groups

Time required: Minimum of 15 minutes

Activity: Using pattern blocks construct various polygons (hexagons, triangles, quadrilaterals, pentagons, etc.) Students can construct a shape and then identify it or choose a shape to construct. The shapes can be compared for similarity.

Evaluation:

Recommended Resources:

Modifications:

Title: Perimeter

Objective: Students will gain an understanding of perimeter, measure perimeters using various measurement tools and practice estimating perimeters.

Materials: Tools for measurement in both english and metric measures (yard sticks, rulers, meter sticks, measuring tapes, metal construction rules), twine or rope

Audience targeted/level: All ABLE levels

Type of setting: Small groups

Time required: 30 min or more, depending on the number of areas to measure

Activity: Using various measurement tools each group will measure around items in the room. The following are examples of the types of items students can find the perimeter of and the lifeskill involved.

windows - weather stripping or moulding

classroom - baseboard or wallpaper borders (Students can develop thinking skills when they determine what part of the perimeter of the room would not need baseboard or borders.)

posters - moulding required for a frame

Estimation skills can be developed by measuring off lengths of twine in various lengths. I like to use one and ten foot lengths. Having pieces of twine in these two measurements enables students to develop a sense of size without the necessity of a specific measurment.

Evaluation: Students have fun with this activity and develop useful life skills.

Recommended Resources:

Modifications:

Title: Pattern Block Perimeters

Objective: To develop an understanding of the concept of perimeter and to use non-standard units to measure perimeter.

Materials: Pattern blocks

Audience targeted/level: All ABLE levels

Type of setting: Small groups

Time required: 15 to 20 minutes

Activity: Using one side of the green triangle as the measurement "unit" the groups will determine the perimeter of each of the other shapes. After each group has determined the perimeter of all the shapes, each member of the group can make a design or pattern and calculate the perimeter. Students can calculate the perimeter of each others designs.

Evaluation:

Recommended Resources:

Modifications:

Title: Understanding Volume

Objective: To develop an understanding of volume, to calculate simple volumes

Materials: Cardboard, tape, rulers, mat knives,

Audience targeted/level: All ABLE levels

Type of setting: Small groups

Time required: 30 minutes prep time (to be done once)

Preparation: Before class or during if desired, cut pieces of cardboard (large boxes work well) into square foot pieces. Six of these pieces can be assembled with wide tape into a one cubic foot block. This block enables students to see what a cubic foot looks like. Over time many of these blocks can by constructed and be temporarily assembled into a cubic yard. Cubic inch blocks can be constructed also or wood blocks can be purchased.

Activity: With the cubic inch blocks construct a cubic foot. With the cubic foot blocks construct a cubic yard. Count the blocks necessary to make each shape.

Using cubic inch blocks fill various boxes to estimate the volume of each box. Use cubic foot blocks to estimate the volume of a file cabinet, storage cabinet or closet. This can be done by estimating how many blocks would fill each drawer or shelf.

Using cubic inch blocks build shapes with blocks. Students might construct regular and irregular shapes similar to illustrations in GED books. Students can use the volume formula to calculate the volume of each solid shape. By counting the blocks required to construct each shape the results of the volume formula can be verified.

Evaluation: By building shapes with blocks, especially irregular shapes, students can better visualize the many ways the volume can be calculated.

Recommended Resources: GED text book with illustrations of irregular shaped volume problems.

Modifications: Any size small block (ABC, or 2 cm.) can be used for this activity. Instead of using cubic inches use cubic units.

Title: Area

Objective: To understand the concept of area, measure the area of shapes and estimate the area of shapes.

Materials: Large sheets of cardboard, paper, graph paper, rulers, matte knives and scissors.

Audience targeted/level: All levels of ABLE students

Type of setting: Small groups

Time required: 30 minutes

Activity: Either before or during the activity each group will measure and cut out a square foot out of cardboard. Students will then estimate how many square inches it will take to cover the square foot. Using paper, students will measure and cut out square inch pieces of paper and glue them to the square foot. How close was the estimate? (Students usually do not need to cover the entire piece of cardboard to develop an understanding of area.)

Using square foot pieces of cardboard, the students can construct a square yard of cardboard. This activity gives visually meaning to the size of a square yard.

Floor tiles are frequently a square foot in size. These can be used to determine area of a floor and give understanding to the unit "square foot."

Using graph paper mark off shapes. How many square units is it? On graph paper draw a rectangle or square of a specific size (8 by 4). Calculate the area using the area formula. Then check your answer by counting the square units inside the shape.

After calculating the area of a square or rectangle, cut the shape in half on the diagonal. This is an easy way to illustrate why the area of a triangle is A=1/2 BH.

Evaluation:

Recommended Resources:

Modifications:

Title: Cube Count

Objective: To visualize the volume of shapes

Materials: Worksheet *(follows)*, blocks if desired

Audience targeted/level: All levels of ABLE students

Type of setting: Small group or individual activity. This works well as a start up activity for class as there will likely be a lot of difference in time required for completion.

Time required: Varied

Activity: Allow a students the opportunity to work in groups to determine the number of cubes in each shape. After allowing time to initially solve the problem ask if students would like to use cubes. Does this make the problem easier? Did any answers change? What would the volume of each shape be?

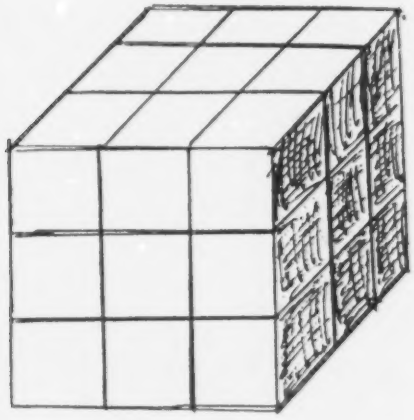
Evaluation:

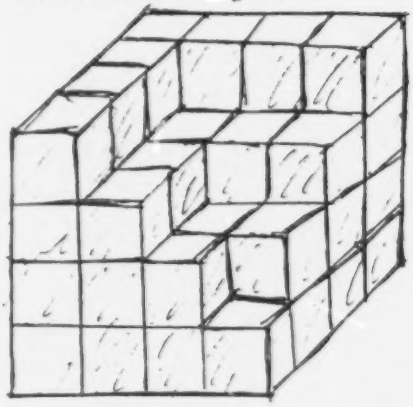
Recommended Resources:

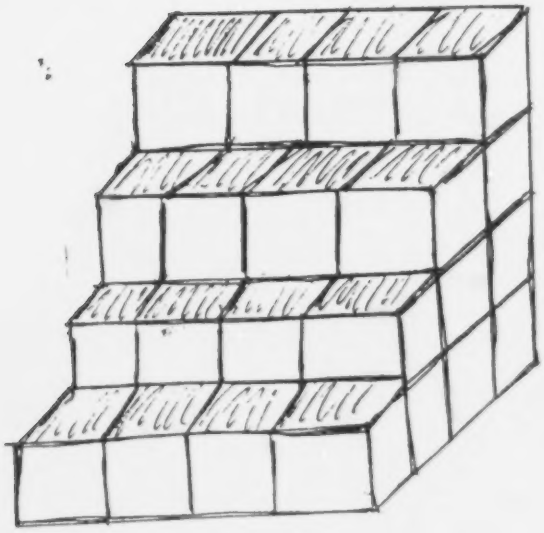
Modifications:

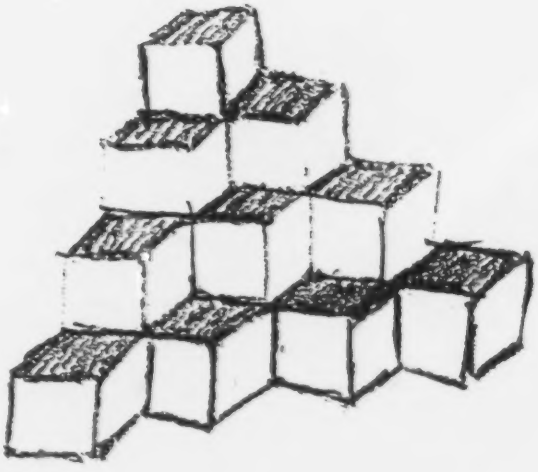
Cube Count

Can you calculate how many cubes are in each of the shapes below?









Title: Circles - Radius, Diameter, Circumference

Objective: To understand radius, diameter, circumference, and pi and the relationship between these concepts pertaining to circles.

Materials: Plastic lids in a variety of diameters, tape measures, rulers, & calculators

Audience targeted/level: All ABLE levels

Type of setting: Small group

Time required: 45 minutes

Activity: Most plastic lids have a dot or a bubble in the center. Use this dot as the center of the circle. Measure from the dot to an edge. this is the radius. Try measuring from the dot to several points on the edge of the circle. (radii should be equal.)

Measure from edge to edge (ruler or tape measure should cross the dot on the lid) This represents the diameter. Measure 2 radii. Is there a relaltionship between the diameter and the radius?

Use the tape measure and measure the outer edge/around the lid. *(This can also be done with string. Just wrap the string around the lid, cut it to length, then use a ruler to measure the string.)* This measurement represents the circumference. Divide the circumference by the diameter. Divide to the nearest tenth.

Tabulate the values of the various lids.

	D	C	C/D
Lid 1			
Lid 2			

Compare C/D values. They should all be at least 3! Explain what pi (π) is *(the ratio of C to D)*. Circumference formula $C = \pi D$. The students are now ready to use the circumference formula to solve problems.

Evaluation: This activity works well with all levels of ABLE students. By working in groups those students with lower math skills can receive assistance with the the division of C/D. Calculators are great to use with this activity too. I've had students comment several weeks after the class how much they enjoyed this activity. They gain an understanding of pi and how math makes sense.

Recommended Resources:

Modifications: If you don't have enough variety in size of plastic lids use other round objects (paper plates, cans, etc). This lesson helps students realize they can estimate the value of π as the number 3.

Title: Area of Squares and Rectangles

Objective: To develop strategies for finding the area of squares and rectangles

Materials: Graph paper

Audience targeted/level: All ABLE levels

Type of setting: Individual or group

Time required: 30 minutes

Activity: Draw several squares and rectangles or various sizes on graph paper. Calculate the areas. Do a number of problems. Develop a formula to show how the area was found.

Evaluation:

Recommended Resources:

Modifications: This same activity could be done except this time the perimeter of the rectangle or square could be found.

Title: Lines and Angles All Around Me

Objective: Students will identify right, obtuse and acute angles. Students will identify perpendicular and parallel lines.

Materials: Classroom supplies, manuscript alphabet, city maps, etc.

Audience targeted/level: All ABLE levels

Type of setting: Pairs or small groups

Time required: 10 minutes or more if desired

Activity: Using objects in the room, students look for examples of different types of angles and line relationships. The groups might compete to see which group can find the most examples in each category.

Using an alphabet chart or sample manuscript alphabet, the students will look for examples of angles and line relationships.

Evaluation: This can activity can serve as a quick way to reinforce understanding of angles and line relationships.

Recommended Resources:

Modifications: A city map can be used to look for angles and line relationships.

Title: Visual Thinking Triangles

Objective: To learn there are many different shapes in a simple diagram.

Materials: Visual Thinking worksheet (follows) or a similar drawing with questions

Audience targeted/level: All ABLE levels

Type of setting: Individual or small groups

Time required: 30 minutes

Activity: Part 1 - Discuss how to name a triangle (using the vertices). Review the properties of the following triangles: equilateral, isosceles, scalene, acute, right, and obtuse.

Part 2 - Use the discovery method. Let the class determine how many triangles there are for each question before it is discussed.

Part 3 - Talk about methods used to be sure that answers are correct. Trace triangles with colored pencils or their fingers. Use a ruler to measure sides to be sure sides are equal. Use a corner to a sheet of paper to prove there is a right angle. Be sure to talk about how triangles overlap and to visualize just the triangle they are looking at.

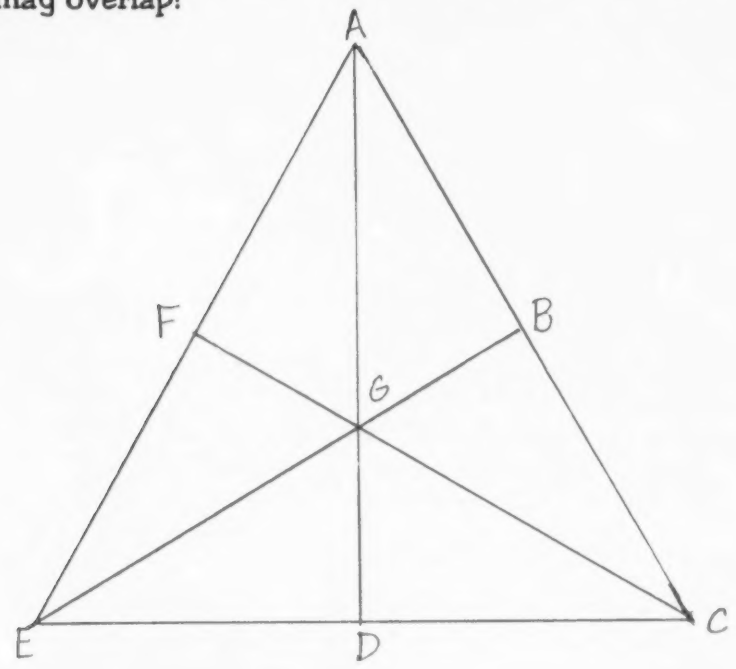
Evaluation:

Recommended Resources:

Modifications: This same diagram could be used to look for right angles, acute angles, obtuse angles, straight angles and reflex angles.

Visual Thinking

The triangle below has three sides of equal length. Answer the following questions by studying the triangle. Don't forget - the triangles may overlap!



1. How many triangles can be found in the figure above? _____

2. How many equilateral triangles are there? _____

3. How many scalene triangles are there? _____

4. How many isosceles triangles are there? _____

5. How many right triangles are there? _____

6. How many acute triangles are there? _____

7. How many obtuse triangles are there? _____

8. How many quadrilaterals can be found in the figure? _____

Title: Wallpaper Geometry

Objective: To introduce students to the geometric concepts of measuring, length, width and area. Students will gain skills in wallpapering, measuring, area formula and working in a group.

Materials: Inexpensive, leftover rolls of wallpaper, (purchased with a discount as a math teacher), scissors, rulers, yardstick, tape, chalk board or tables.

Audience targeted/level: Multi-level - I, II, III

Type of setting: Groups of three to four students

Time required: 1 1/2 to 2 hours, depending on length of introduction to the concepts and formulas for area and perimeter.

Activity: Each group chooses a person to lead, measure, cut and tape. The leader chooses the area to be covered (chalkboards or tables arranged to simulate walls, see illustration below) and chooses the wallpaper with consideration of his groups advice.

Students learn to "match" the pattern by trial and error. Paper is taped in place.

Evaluation: Students learned cooperation and problem-solving in a group. Most were enthusiastic about the project. In fact, they were so enthusiastic that a member of each group took home the remainder of the roll and the cut pieces to use at home.

Students also learned the importance of accuracy and dedication to their project. Group skills were noted and discussed. Rewards were given to the whole class for their cooperation and one group was singled out for an extra prize for their outstanding professionalism.

Recommended Resources:

Modifications.

Title: Reading House Plans

Objective: To distinguish between perimeter and area, to apply the theoretical concepts of perimeter and area to practical situations

Materials: Floor plans from the local newspaper or home magazines (Better Homes and Gardens, Country Living). Copy and enlarge the plans, add dimensions for the rooms if needed. See example which follows.

Audience targeted/level: Pre-GED or GED

Type of setting: Small groups

Time required: 30 to 45 minutes. More depending on the number of tasks and calculations required.

Activity: Use this lesson as a review or reinforcement of the concepts of area and perimeter. Students will practice finding perimeters for "baseboards" and areas for cement and carpeting. Calculate the number of square tiles (1 foot and 9 inch) for bathrooms and basements. The activity also reinforces decimal multiplication.

Evaluation:

Recommended Resources: Contemporary's *Real Numbers: Geometry Basics* (p. 45) has a good example of this type of activity.

Modifications: This activity can be extended even more by actually calculating costs for the carpet (changing square feet to square yards is necessary for this), baseboard, amount of paint needed in rooms, etc.

Title: Triangles, Triangles, Triangles

Objective: To evaluate a group of triangles for differences.

Materials: Paper, pencils, and scissors

Audience targeted/level: All

Type of setting: Classroom or small groups

Time required: 15 to 20 minutes.

Activity: Draw a series of 5 triangles. After the first one is drawn, make sure each of the next ones is different in some way. Write down the reasons why each triangle is different.

Evaluation: This activity can be done on many different levels. The amount of knowledge of geometry which a student has will influence their statements.

Recommended Resources: Van De Walle, John A. Elementary School Mathematics: Teaching Developmentally,2nd. edition. Longman Group Ltd., New York, 1994.

Modifications:

Title: Shapes with Triangles

Objective: To study the differences in perimeter of several shapes with an area 10.

Materials: Isometric dot grid paper (see next page), plain paper which can be used for tracing (if desired), pencils

Audience targeted/level: All ABLE levels

Type of setting: Individuals, pairs or small groups.

Time required: 15 to 20 minutes

Activity: Using a sheet of dot grid paper, each individual will draw several figures each having an area of 10 small triangles. All students must construct their figures so these rules are followed:

1. Lines must connect adjacent dots only.
2. All shapes must be simple closed figures.

After drawing 3 to 4 different shapes students will determine the perimeter of each figure and record it next to each figure. What observations can be made about the shapes? Draw more figures to explore and study the observations.

Evaluation: Discuss with the students the types of figures drawn, etc. Did everyone in the group draw the same type or style of figure?

Recommended Resources:

Modifications: Try this activity with square grid paper. How would the area and perimeter relate then. What would the shape with the largest and smallest perimeter look like? What would happen if you built three-dimensional boxes out of cubes? How would the surface area of the box change?

Title: Geometry in the Bathroom: Tile Patterns

Objective: To study how shapes fit together to form patterns.

Materials: Colored paper, shapes for tile patterns (See below), scissors, pencils

Audience targeted/level: All ABLE levels

Type of setting: Individual or small groups

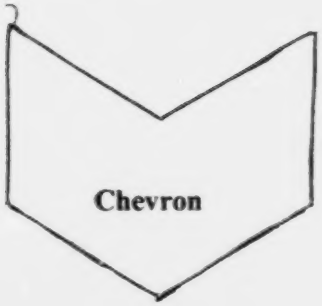
Time required: 15 to 20 minutes

Activity: Each person will make at least 8 copies of one of the tile shapes given. *(One was to do this is to fold the colored paper into 8 thicknesses. Trace the shape on the top sheet and cut out through all 8 layers.)* The pieces which have been cut out are your bathroom tiles. Your job is to design a tiling pattern. *(Tiling patterns made with one shape have two important properties. 1. There are no gaps or wholes in the pattern. 2. The pattern repeats and could go on forever.)* Play with the tiles until you decide on a pattern you like.

Evaluation:

Recommended Resources: Van De Walle, John A. Elementary School Mathematics: Teaching developmentally, 2nd Edition. Longman Group Ltd., NewYork, 1994.

Modifications: Tiling patterns can also be done with pattern blocks.



Title: Cooperation squares and Circles

Objective: To demonstrate working cooperatively with a team on a common task.
To practice spatial skills be assembling squares and circles.

Materials: Directions for *Cooperative Squares and Circles* (follows), Packets of 15 pieces (one packet per work crew - patterns follow), job descriptions for four different Job Observes (follows), process questions to use after game (follows)

Audience targeted/level: All ABLE levels

Type of setting: Teams of three

Time required: 30 to 45 minutes

Activity: Form "work crews" of three students. Select one or more Job Observers to make each of the following reports: Cooperation and Teamwork, Non-verbal Communication, Leadership and Management, Infractions of Company Policy. Give the job description to each Job Observer. These students are not part of the work crews. Play the game (refer to rules). Remember work crews can not communicate orally to complete the task. Upon completion of the game ask the process questions and have job observers give their reports.

Evaluation: This is a great activity to reinforce spatial skills and job skills. The process questions can be completed as a group activity or as a written assignment. This is a good activity to use as an introduction or follow-up to a discussion of learning styles.

Recommended Resources: Ideas that Work for ABE: Activities and Resources for Competency-based Adult Basic Education. Oregon CBE Curriculum Committee, 1990-91. (Funded by a 353 Grant under the Adult Education Act)

Modifications: The role of the job observers could be used in many cooperative learning situations. The same activity could be done with shapes other than squares.

Cooperation Squares and Circles

A wonderful way to demonstrate
work maturity skills

Directions: You work in a Perfect Square (Circle) assembly factory called Cooperation Squares/Circles Corporation. Your supervisor will give your work crew a packet of cut pieces. Each packet contains 15 pieces. Your work crew's job is to assemble **five (5) squares** that meet the following criteria:

- Each square is made up of 3 pieces
- All 5 squares are the same size

This is a noisy factory, so you must communicate with your co-workers ***through eye contact, gestures, and motioning only. NO TALKING IS ALLOWED.***
Please cooperate with your co-workers to complete the assembly of these squares.

Variation: Use large pieces and put a tab with the name of a player on some pieces in each pack. That player can only "work" with the pieces with her/her name on them and must work with others to move the pieces into squares (or circles).

Job Observers: Job Observers are in charge of "Quality Control" for the Cooperation Squares Corporation. While the work crews are assembling the squares (circles), four different types of Job Observers will be watching the crews for specific behaviors that demonstrate cooperation and teamwork, leadership and management, non-verbal communication, and infractions of company policy. The Job Observers will report to the supervisor at the end of the workshift.

Process Questions After the Play:

- In what ways was cooperation important (useful) during the game?
- How did you feel when someone held a piece and did not see the solution?
- What was your reaction when someone finished one square and then sat back without seeing that s/he held a key piece to the other squares?
- What were your feelings if you finished a square then began to realize that you would have to break it up and give it away to make ALL of the squares work?
- How did it feel to be the first/last group to finish?
- How can you relate this to working with others...
  - ...when someone works too slowly?
  - ... when someone takes tools/jobs away from you before you can do it yourself?
  - ...when you like to look things over, then take action, but others are jumping in and moving things around?
  - ...when you like to jump in and get things done, but others are planning and thinking it all through first, and taking too long to get the job done (by your standards)?
- How can you learn to adjust/adapt to others' work pace/quality standards while on the job?

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Job Observer
Cooperation and Teamwork

You are in charge of "Quality Control" for the **Cooperation Squares Corporation.** It is your job to watch the employees work (without interacting with them in any way while they are "on the job"), make specific observations, report to the workcrew (at the end of the workshift), and eventually report to your Supervisor – who will report to the Board of Directors.

Notice and report to the group examples of ***Cooperation and Teamwork*** on the job. This could include:

- Offering pieces to a co-worker
- Gesturing to keep the activity moving
- Two co-workers working on the same square together
-
-

Job Observer
Non-verbal Communication

You are in charge of "Quality Control" for the **Cooperation Squares Corporation.** It is your job to watch the employees work (without interacting with them in any way while they are "on the job"), make specific observations, report to the workcrew (at the end of the workshift), and eventually report to your Supervisor – who will report to the Board of Directors.

Notice and report to the group examples of ***Non-verbal Communication*** on the job. This could include:

- pointing
- finger clicking to call attention to a move you propose
- eye contact
-
-

Job Observer
Leadership or Management

You are in charge of "Quality Control" for the **Cooperation Squares Corporation.** It is your job to watch the employees work (without interacting with them in any way while they are "on the job"), make specific observations, report to the workcrew (at the end of the workshift), and eventually report to your Supervisor – who will report to the Board of Directors.

Notice and report to the group examples of ***Leadership or Management skills*** demonstrated by any of the employees on the job. This could include:

- Offering pieces to a co-worker
- Gesturing to keep the activity moving
- Two co-workers working on the same square together
-
-

Job Observer
Infractions of Company Policy

You are in charge of "Quality Control" for the **Cooperation Squares Corporation.** It is your job to watch the employees work (without interacting with them in any way while they are "on the job"), make specific observations, report to the workcrew (at the end of the workshift), and eventually report to your Supervisor – who will report to the Board of Directors.

Notice and report to the group any B you observed on the job. This could include:

- Verbal communication
- Attempting to touch or move another worker's "tools" (pieces of squares)
- Attempting to assemble a square with the wrong number of pieces (only 3 per square)
-
-

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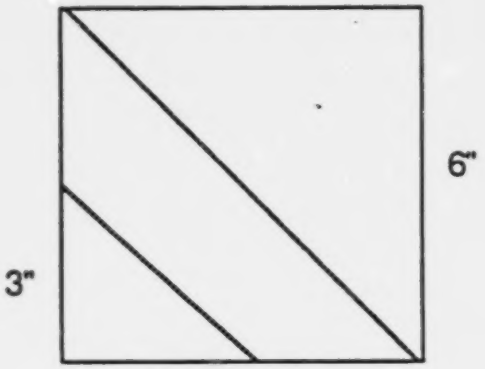
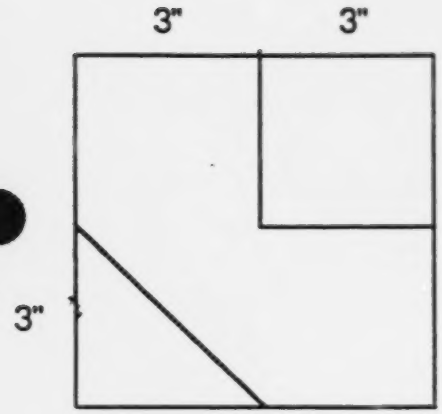
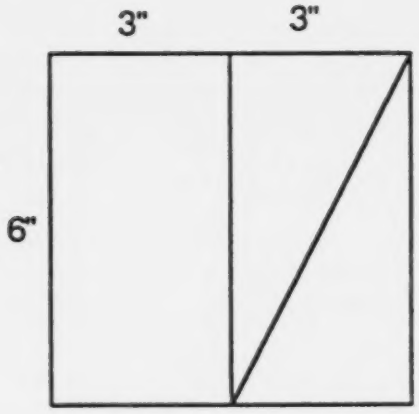
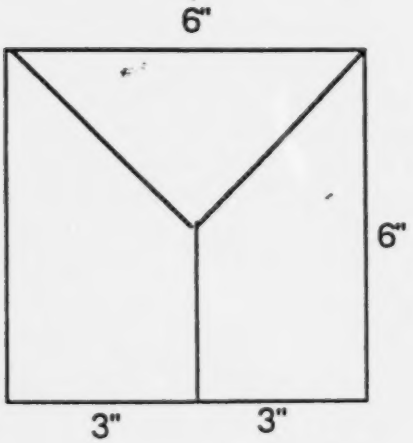
Pattern for cut pieces of Perfect Squares

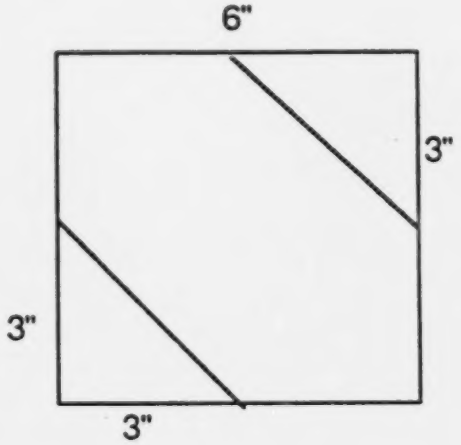
- Cut out five 6" squares
- Cut each square into 3 pieces as shown here
- Include all 15 pieces in one packet











Title: Discovering Pi

Objective: To discover that the distance around a circle divided by the distance across equals 3.4 or pi

Materials: Circular items: ie. coffee can, plate, umbrella, round table, frisbee, etc.
Measuring tapes, one per group
Recording chart (sample follows)

Audience targeted/level: ABLE levels II and III

Type of setting: Small groups of three

Time required: 20 to 30 minutes

Activity: Put numbers on circular items. Place items on tables around the room. Divide the class into teams of three. The three team members rotate roles with each new item:

Recorder - record measurements, division answer
Measurer - measures items
Divider - does division

Teams rotate from item to item and do the following:

Measure distance across and distance around
Divide distance across into the distance around.
Record answers on the chart.

After all groups have measured each item, answers can be compared in the large group.

Evaluation: If the work was done correctly all answers should be about 3.

Recommended Resources: Ideas that Work for ABE: Activities and Resources for Competency-based Adult Basic Education. Oregon CBE Curriculum Committee. 1990-91.

Modifications:

Discover Π Worksheet

Distance across ⟌ Distance around

Item number	Distance across (through center)	Distance around	Result
# 1			
# 2			
# 3			
# 4			
# 5			
# 6			
# 7			

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Title: Classroom Makeover

Objective: To measure the area of the room and use this information in practical applications.

Materials: Tape measures or steel rules, and shopping ads for carpeting, paint, window blinds, etc.

Audience targeted/level: All levels

Type of setting: Small groups, individuals if desired.

Time required: 2 hours

Activity: Students measure and record the area of classroom floors, windows, and walls. Next they find the cost of carpeting, window blinds, and paint at local stores that would be needed to do a "classroom makeover."

Evaluation:

Recommended Resources: Ideas that Work for ABE: Activities and Resources for Competency-based Adult Basic Education. Oregon CBE Curriculum Committee. 1990-91.

Modifications: Students could measure rooms in their homes to "decorate."

Title: Toothpick Puzzles

Objective: To develop skill in working with spatial relationships, to develop problem solving skills, and practice creating equal areas and shapes.

Materials: Toothpicks

Audience targeted/level: Pre-GED and GED

Type of setting: Pairs

Time required: 20 to 40 minutes

Activity: All students are given a supply of toothpicks. The object is to arrange to the toothpicks into straight lines to make triangles. Students first attempt to make a triangle with 3 toothpicks, then 4, 5, and so on. Before they attempt of construct each triangle they determine if a triangle is possible. They then sketch the solution. They then determine if another solution possible with the same number of picks. Students might make a chart of their findings. they should be encouraged to examine why certain triangle are impossible and certain concepts. *(i.e. The sum of any 2 sides of a triangle must be greater than the third side.)*

Students can also attempt to construct various triangles, hexagons and other geometric figures as directed *(see next page)*. The activities give them practice in problem solving and analytical thinking.

Evaluation: Doing spatial problems similar to these enable other students to excel. Your best students may not be best with these activities.

Recommended Resources: Downie, Diane. Math for Girls and Other Problem Solvers. EQUALS, Lawrence Hall of Science, University of California, 1981.

Other useful toothpick problems can be found in kids' math puzzle books.

Modifications: After completing several toothpick puzzles the students can make up original puzzles to share with one another.

Toothpick Activities

1. Construct this shape using 17 toothpicks.
Try to remove 5 toothpicks so 3 squares remain. Can you remove 6 toothpicks so 2 squares are left?

2. Construct this hexagon with 12 toothpicks.
Can you remove 4 toothpicks so 3 triangles are left? Try to move 4 toothpicks to form 3 triangles.

3. Use 8 toothpicks and a cheerio to form this fish.
Can you move 3 toothpicks and the cheerio to make the fish swim the opposite direction.

4. Two families own land in this shape.
The first family wants to divide their land evenly among their 3 children. Add 4 toothpicks to form 3 parcels of land of equal size and identical shape.
The second family wants to divide their land evenly among their 4 children. Using 8 toothpicks divide the land into 4 lots of equal size and identical shape.

5. Use 9 toothpicks to construct this triangle.
Remove 2 toothpicks and leave 3 triangles. Remove 3 toothpicks and leave 1 triangle. Remove 6 toothpicks and get 1 triangle. Remove 4 toothpicks and get 2 triangles. Remove 2 toothpicks and get 2 triangles.

6. Can you use 6 toothpicks to construct 4 equilateral triangles *(You may need to change your perspective for this one!)*

ALGEBRA: PATTERNS AND FUNCTIONS

The area of algebra, both formal and informal, presents a challenging dilemma, because although educators want this included, learners often react in a negative manner, with personal stories of frustration and agony. When adults reflect upon what it means to do algebra, they tend to recall formal methods of equation solving, age problems, and lots of X's and Y's. But mathematics educators at all levels have begun a dialogue with a very different emphasis on conceptual understanding, on algebra as a means of representation, and on algebraic methods as a problem solving tool. They are not talking about the mechanical high school algebra but algebraic reasoning that allows us to think about and express patterns, relations and functions and which ultimately gives many more people access to technology.

Many frustrations are connected to past experiences with algebra. Many adults cite algebra as a major stumbling block in their earlier math education, the place where they got stuck..Whatever the reason, many learners report an incredible disconnect at the point where algebra is traditionally introduced.

There is a widely held notion that algebra is not practical, relevant or useful. Yet algebra is a bridge between arithmetic and more broadly generalized mathematical situations. Mathematics is the study of patterns. These generalizations can be expressed in the notation of formulas and graphs. **Many life and work experiences can be expressed in algebraic terms.** While most learners do not see the relevancy of algebra, and many teachers see the academic relevancy, employers and other workers do see application to today's workplace. Life experience should afford adult basic education teachers with a broad base of real-world ties which can be readily linked to the concepts of equation, function, variable and graph.

Algebraic thinking skills are crucial if adults are to compete in the global economy: therefore all adult learners should have the opportunity to improve in that area. Algebra impacts the competency of workers, parents, and citizens. While basic skills are obviously important, it is also useful to have working knowledge of algebraic language. This way of thinking, critically and analytically, contributes to one's daily thought process. Any adult who can think more systematically and analytically is bound to be a better citizen, worker and parent. Better thinkers think ahead. Thinking algebraically influence all areas of our lives.

IMPLICATIONS FOR LEARNING AND TEACHING

It is necessary to introduce all learners to algebraic concepts by making links to the learner's experiences.

We must pay attention to instructional pace, vary teaching strategies and strengthen the development of concepts to improve algebra instruction. It has been suggested that the source of trouble might have to do with the pace of the instruction. Learners, too, need time to assimilate the material and reflect upon it.

Stressing logic puzzles, "function machines", tables and graphs, as well as the concept of what an equation really means are all strategies to help build algebraic thinking.

LARGE GROUP :

Discuss:

What is the purpose of a graph or chart?

- quick impression
- picture display of information
- good way to compare information, draw conclusions
- drawn rather than written

Individual:

Demonstrate: Real Graph/ Symbol Graph/ Bar Graph

Pass out 10 tiles to each member of the group.

1. Each member separates and counts the tiles by color.
2. Line them up by color so they make column.
3. Compare the columns.
4. You made a real graph, from real objects.
5. What symbol can we use to represent a tile?
6. Make a graph using the symbol to show how many tiles .
7. Instead of symbols, we can use a bar to show the number of tiles .
8. Draw bars showing the number of tiles. Do your bars go up and down? That is a vertical bar graph. If they go across, that is a horizontal bar graph.

Small Group:

Demonstrate

Circle Graph

Circle graph compares parts of a whole, line graph shows trends

1. How many total tiles do we have? How many red tiles do we have? (Again, this count can be taken individually, small group and large group to reinforce process)
2. The total goes on the bottom and the red goes on the top.
3. Take number of green tiles over the total.
4. Take the number of **black** tiles over the total.
5. Make a circle and divide according to fraction. (Hint, you can also convert to percent by dividing the total into the number of colored tiles.)

Large Group:

1. Get information from each group and demonstrate process with results from whole class.

Small group

Demonstrate: Line Graph

1. Select a recorder to write down the number of red tiles that each student has, the number of **black** tiles each student has and the number of green tiles each student has.
2. Now, pass out markers, graph paper, and pencils to each group.

Discuss in Large group

Let's look at the things necessary to make a line graph.

We need: A title

A constant

A variable.

constant = *stays the same* variable = *changes or has potential to change.*

Where can they be found?

Use newspapers, magazines, leaflets, any everyday information you might have that shows graphs.

You may do this as a large group activity and you provide the pictures as example OR bring in old magazines and let small groups of students find examples of graphs.

Answer the following questions about the graphs

- *What is the title?*
- *What type of graph?*
- *How does it work?*

Large Group:

Coordinates

Discuss:

1. Go to the line graphs and read the next point about Cartesian plane.
2. It's the graphing of points on a plane that allows us to draw graphs or pictures of algebraic expressions.
3. The coordinate plane is the **grid** (graph paper). Pass out another sheet.
4. The numbers that name the intersection are called **ordered pairs**. For example, the ordered pair (3,2) names third across, second down.

   Always read horizontal, then vertical.
5. These intersections are called **points**. The ordered pair is always shown in parenthesis.
6. The coordinate plane (grid) has a horizontal plane and a vertical plane which is numbered.
7. The point at which the axis meet is called the **origin**.

Demonstrate:

1. Draw a grid on the board (3 by 3)
2. Plot (1,1) =A , (1,3)=B, (2,3)=C, (3,2)=D and explain intersection and points as you go. Remember: **horizontal then vertical**
3. Now let the class draw a 3 by 3 on paper and plot the following:

   E= (2,2), F= (3,3), G = (1,2), H= (2,1)

Cartesian plane using both positive and negative numbers

1. So far we've worked with only positive numbers. Can you think of instances where both positive and negative numbers may be used?
2. Pass out graph paper.
3. Draw a cross on the board and label 1,2,3, both positive and negative.
4. Show the 4 **Quadrants** in this graph instead of 1.
5. Plot I= (-1,1), J= (3,-2), K= (-2,3) L= (-3,1) **horizontal then vertical**
6. Now, it's your turn. Plot M= (1,-1), N= (2,3), O= (3,-1), P= (-2,3)

Small Group

1 . Coordinate Tic Tac Toe: Ask group to divide into groups of 2 to play tic tac toe. Start them off with you naming the numbers and they plot.

2. After you have demonstrated how this works, they should be able to play with each other for about 5 minutes.

Large Group

1. **Hurkle:** Pass out more paper. Leader decides where Hurkle is.
2. Leader announces "Hurkle is hiding on a point.
3. Group guesses
4. Give clues, N,S,E,W,SW,NE, etc.
5. First team to guess location wins.

ALGEBRA NEWS ▲▼▲▼▲▼▲▼▲▼▲▼▲▼▲▼▲▼▲▼▲▼▲▼

Combining Positive and Negative Numbers

Use playing card language.

+4 to the good	-4 in the hole	-4 in the hole	+4 to the good
+3 to the good	-3 in the hole	+3 to the good	-3 in the hole
+7 to the good	-7 in the hole	-1 in the hole	+1 to the good

Division and Multiplication Signs

+ + }	same day	+ - }	mixed up day
- - }	good day	- + }	bad day

or

(+8) (+4)
I can go to the store. = +

(-8) (+4)
I cannot go to the store. = -

(+8) (-4)
Yes, I cannot go to the store. = -

(-8) (-4)
No, I cannot go to the store. = +

Balancing Equations

Hold up both hands - Are they equal?
Add two pencils to the right hand - Are they equal?
How do you make it equal?

Algebra as a Game

Know the rules-

Rule 1 - Set up problem
Rule 2 - Combine like terms
Rule 3 - Inverse operations
A. Multipy and/or divide first
B. Add and/or subtract second

Order of Operations Acronym

Please Excuse My Dear Aunt Sally
parentheses, exponents, multiplication and division, addition and subtraction

Simplify: $6(8 - 11) + 2$

Parentheses	$6(-3) + 2$
Exponent	$6(-3) + 8$
Multiply	$-18 + 8$
Add	-10

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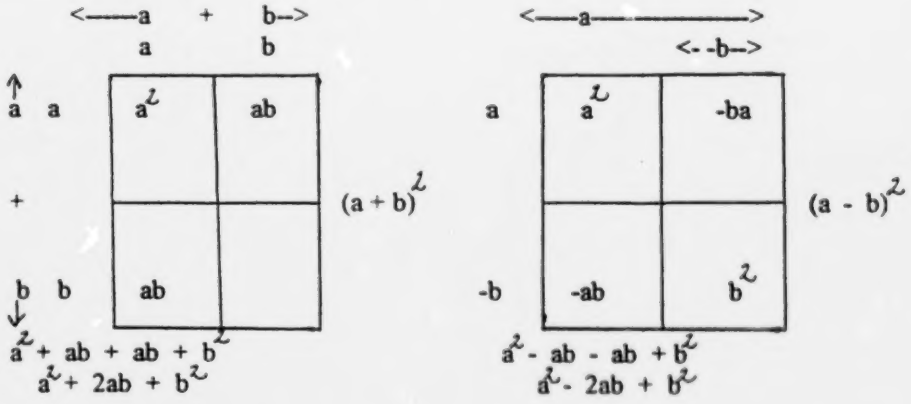
Multiplication of Polynomials

FOIL Method F=First O=Outer I=Inner L=Last

$(a + b)^2 = (a + b)(a + b)$ $\quad a^2 + ab + ba + b^2$

$a^2 + 2ab + b^2$

PICTURE Method



Regular Multiplication

$$\begin{array}{r} a + b \\ \underline{a + b} \\ ab + b^2 \\ \underline{a^2 + ab\ \ \ } \\ a^2 + 2ab + b^2 \end{array} \qquad \begin{array}{r} a - b \\ \underline{a - b} \\ -ab + b^2 \\ \underline{a^2 - ab\ \ \ } \\ a^2 - 2ab + b^2 \end{array}$$

Setting Up Word Problems

READ - Do you add, subtract, multiply, or divide?
Who or what is involved? Change names to familiar ones.
READ - Who or what do you know nothing about?
READ - Read backwards in phrases.

EXAMPLE: A contractor needs to order windows for a building she is constructing. The building has four sides and each side requires 53 windows. How many windows will be needed?

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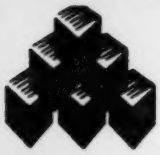

ALGEBRA GLOSSARY ▲▼▲▼▲▼▲▼▲▼▲▼▲▼▲▼▲▼

ALGEBRA The study of expressions containing variables.

ALGEBRAIC EXPRESSIONS
Two or more numbers or variables combines by addition, subtraction, or multiplication. (1.e. X + 6 = or 3/5 =)

EQUATION A mathematical sentence written with symbols. A mathematical sentence can be true or false. A SOLUTION makes the equation true. Any other value makes the equation false.

EXPONENT Tells how many times a number is multiplied by itself.

"LIKE TERMS" Terms that have exactly the same variable parts. (i.e. 2X, 5X, 1/2X = like terms)

NEGATIVE NUMBERS
Those numbers smaller than zero.

NUMBER LINE Looks like a thermometer scale on its side. Negative numbers you solve that which is in parenthesis (if there is more that one set, work from the inside out), then work the exponents, then the multiplication, then the division, then the addition and subtraction.

POLYNOMIAL A special kind of algebraic expression. A polynomial has one or more terms combined by addition or subtraction.
A polynomial with one term = nomial.
A polynomial with two terms = binomial.
A polynomial with three terms = trinomial.

POSITIVE NUMBER Those numbers larger than zero.

"UNLIKE TERMS" Terms that have different variable parts. (i.e. 3X and 7Y = unlike terms)

VARIABLES Letters that stand for an unknown numerical value that changes from problem to problem. (i.e. X + 13 = 25 or 8 - X = 4)

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Compton's Interactive Encyclopedia. Compton's NewMedia Inc., 1994.

Laycock, Mary and Margaret A. Smart. Manipulative Interludes Algebra. Activity Resources Company, Inc., 1990.

Saunders, Hal. When Are We Ever Gonna Have to Use This?. Dale Seymour Publications, 1988.

Stenmark, Jean Kerr, Virginia Thompson, and Ruth Cossey. Family Math. University of California Regents, 1986.

RESOURCES

The math materials developed for adult learners need to be seriously revised. Most of the materials presently available often reflect some of the worst traditions of the K-12 mathematics education. There seems to be little awareness of the need to provide learners with practice in process skills, such as reasoning and problem solving. Very few materials offer open-ended or cooperative problem solving activities for adult learners.

As the focus groups looked for materials and suggestions in keeping with the spirit of mathematical understanding and reform, we found some excellent materials from other sources. These sources were often written for middle school mathematics. While teachers must be careful to maintain the dignity of and the respect for their students, these materials can often be easily adapted to the adult education classroom. Some of the best materials we found are listed on the following pages. Many are available from large educational publishers such as Dale Seymour, Creative Publications, etc.

RESOURCES

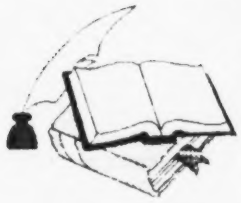
What's Happening in Math Class? Envisioning New Practices Through Teacher Narratives edited by Deborah Schifter, International Reading Association, 800 Barksdale Road, Newark, DE, 19714.

FAMILY MATH, by Jean Kerr Stenmark, Virginia Thompson and Ruth Cossey, Lawrence Hall of Science, University of California, Berkeley, CA 94720 (510-642-1910).

GET IT TOGETHER: Math Problems for Groups - Grades 4-12, edited by Tim Erickson, Lawrence Hall of Science, University of California, Berkeley, CA 94720 (510-642-1910).

MAKE IT SIMPLER: A Practical Guide to Problem Solving in Mathematics by Carol Meyer and Tom Sallee, Addison-Wesley Publishing Company, Menlo Park, CA.

Math for Girls and Other Problem Solvers by Diane Downie, Twila Slesnik, and Jean Kerr Stenmark, Lawrence Hall of Science, University of California, Berkeley, CA 94720 (510-642-1910).



GOOD TEACHER RESOURCES

Fear of Math
Claudia Zaslavsky
Rutger University Press
United States 1994

Math Anxiety Reduction
Robert D. Hackman
H&H Publishing
United States 1985

I Hate School
Claudine G Wirths & Mary Bowman-Kruhm
Harper & Row Publishers
United States 1987

Helping Children Overcome Learning Difficulties
Jerome Rosner
Walker and Company
United States 1993

Time For College
Al Siebert & Bernadine Gilpin
Practical Psychology Press
United States 1989

"I've Forgotten Everything I Learned In School"
Marilyn Vos Savant
St Martin's Press
United States 1994

The Unauthorized Teacher's Survival Guide
Jack Warner and Clyde Bryan
Park Avenue
United States 1995

Resources

Math in the Supermarket by Larry Parsky. Pub. by Educational Design, Inc. (1994)

Life Skills Mathematics and Mathematics for Consumers by August V. Treff and Donald H. Jacobs. Pub. by American Guidance Servicesm, Inc. (1992)

Lifescenes Lifeskills by Calvin Stone, Penny Fitzgerald, and Janet Weitz. Pub. by Contemporary Books (1986)

Connections--Life Skills Mathematics ed. by Elizabeth Strauss. Pub. by Steck-Vaughn Company (1992)

Essential Mathematics for Life, Books 1-8 by Mary S. Charuhas and Dorothy McMurty. Pub. by Glencoe/McGraw Hill (1996)

Math Matters for Adults, Fractions, Decimals and Percents, by Karen Lassiter. Pub. by Steck-Vaughn Company (1993)

Harvest Health at Home by Ext. North Dakota State University, Fargo ND. 58105 April 1993 issue

Calories in Fast Foods and More by Ohio Department of Health. Pub. 5/94

Critical Thinking with Math by Karen S. Digilio. Pub. by Contemporary Books (1989)

Measure Up by Charles H. Kahn, Sylvia K. Herring, and Robert Tong. Pub. by Fearon, Janus, Quercus (1968)

Consumer Math Success Kit by David E. Newton. Pub. by J. Weston Walch (1983)

Fearon Time Savers Pub. by Fearon Janus

Budgeting Know-How Pub. by Cambridge Book Company

RESOURCES

Geometry and Graphing, Incentive Publications, 1995 (black line master)

Jumbo Math Yearbook, ESP Publishers, Inc. 1996 (black line master)

Math Topics Grade 6, Instructional Fair, 1996 (black line master)

Number Power 4 Geometry, Contempory, 1989

Refresher, Steck-Vaugh, 1995

Word Problems Grade 8, Instructional Fair, 1996 (black line master)

Adult Numeracy Practitioners Network ANPN
Membership Application Form

(Please Print)

Name: _____ New Member ☐

Title: _____ Renewal ☐

Check Preferred Mailing Address:

☐ Home Address ☐ Work Address

Street: _____
City: _____
State: _____ Zip: _____
Phone: ( ) _____

Institution: _____
Street _____
City: _____ State _____ Zip _____
Phone: ( ) _____
FAX: _____
E Mail: _____

National Council of Teachers of Mathematics Member:

☐ Yes ☐ No

Primary Areas of Interest in Numeracy:

- ☐ ABE
- ☐ ASE/GED
- ☐ ESOL
- ☐ College Developmental
- ☐ Workplace
- ☐ High School
- ☐ Community College
- ☐ College/University
- ☐ Calculators
- ☐ Computers
- ☐ Professional Development
- ☐ Family Literacy
- ☐ Research

Professional Responsibilities:

Adult Education Instructor

- ☐ Full-time
- ☐ Part-time
- ☐ Volunteer

- ☐ Teacher Educator/ Staff Developer
- ☐ Program Director or Administrator
- ☐ Graduate Student
- ☐ Adult Education Student
- ☐ Other _____

Annual Dues for ANPN Membership

- ☐ Individual, $10
- ☐ Local Program/Organization, $50
- ☐ State Program/Organization, $150
- ☐ Student, $5

Dues money enclosed $_____

Date _____

Mail this application and a check or money order payable to:

ANPN
c/o Rose Steiner
595 Revolution Avenue
Billings, Montana
59105